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Volume 58, No.3
March 1996

Electronics AUSTRALIA with Professional Electronics & ETI

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

DVD players on display

The standards for digital video disc technology were only agreed upon late last year, but already many of the major manufacturers had working prototypes on display at the Las Vegas Consumer Electronics Show. Louis Challis found them very impressive, and expects DVD to have a big future. Learn more in his Show Report, starting on page 10.

12V subwoofer adaptor

We've described various filters and bridge-mode adaptors for driving a subwoofer; but as yet, none has been suitable for use in a car. Now, though, in response to many requests, Rob Evans has designed one specifically for operation from 12V — see page 72.

On the cover

When contributor Robert Priestley had finished the Car Computer design described in this issue (see page 58), he arranged for a friend to try it out in a cross-country 'bash'. The computer came through with flying colours, although as you can see the rally car acquired a few minor changes to its bodywork...

Video and Audio

Features

Projects and Technical

Columns and Comments

Departments

Professional Electronics

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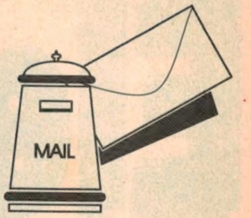
LETTERS TO THE EDITOR



Happy customer

I would like to share with you a pleasant experience I had recently with SONY Corp.(Aust).

I purchased a Sony 2001D portable receiver a few years ago — you may be familiar with the model... It worked quite well until August 94, at which time a fault developed which caused the display screen to black out and for all switches etc., to go open circuit. The only way I could turn the darned thing off was to remove the batteries!

I promptly sent it down to Sony in Sydney for repair. After a few weeks I received it again and tried it out. It worked fine for all of two hours, then the same fault returned again. So I promptly returned it once again to Sony.

To shorten this story, it transpired that I subsequently returned the radio with the same recurring fault four times between August 94 and September 95, at which time Sony took pity on me and decided to replace the unit entirely. Of course the 2001D was no longer available. They sent me a brand new ICF-SW77 portable receiver, which incorporates more bells and whistles that you could shake a stick at.

Now I call that service back-up!

It's good to be able to report a good tale for a change... I hope you will be able to print this. It would be a nice 'thank you' to Sony from me.

John Brennan (VK4SZ),
Innisfail, Qld.

Smoke detectors

The installation of smoke detectors in houses and commercial premises is being actively encouraged as a means of reducing death and injury caused by fire. Indeed in some States, this may soon become compulsory. As a result many thousands of units are already in place and the number will eventually be in the millions.

I understand that there are several types of smoke detectors. The type that I feel may need investigation uses a radioactive source.

The source, I believe, is a small quantity of the element Americium. Many people may be worried to learn that a source of radioactivity, however small and shielded by a metal plate, is positioned just a few feet away for many hours of the day and night.

Americium is a highly dangerous substance. According to a standard reference book The Handbook of Chemistry and Physics published by CRC Press Inc, 'Americium must be handled with great care to avoid personal contamination. As little as 0.03 microgram of Am241 is the maximum permissible total body burden'.

With so many units in the home and work place it is inevitable that some of them will fall into the hands of people unskilled in the handling of radioactive substances. I can imagine inquisitive children and adults pulling detectors to pieces just to see what is inside. Electronic servicemen may attempt to fix faulty units and so on. And eventually some will be despatched to the tip, along with building rubble.

I feel that Electronics Australia could do the community a service by investigating the whole matter in depth. There are several questions which need to be answered, including:

- What is the principle of operation of detectors which rely on a radioactive source?
- Why use a radioactive source at all if safe solutions are available?
- How much Americium is present in such detectors?
- What precautions should be taken when handling such detectors?
- What should be done if a child for example is suspected of having been in contact with the source?

Alan Elliott, VK3AL,
South Melbourne, Vic.

Crossover correction

Your July '96 issue describes the crossover network of the 'Super Mini' Jaycar/Vifa JV20 Bookshelf Loudspeakers as being a 'Linkwitz-Riley second order'.

In fact it is nothing of the sort, because the Q of the HP section is 0.988 in the crossover region.

This comes about because the D25SF tweeter is resistive in that domain (~5.6 ohm); this impedance is augmented by a 3.3 ohm series resistor, and Q=Rx(4.7 microfarad/0.39 millihenry)$^{1/2}$.

On the other hand, the L-R is characterised by a Q of 0.49, (even lower than the 2nd order Butterworth's 0.707).

As for the LP section, it may be regarded either

a) as 1st order Butterworth, (if one focusses on the filter alone), with the 0.22mH inductor working into a resistive load (the woofer's impedance corrected by the Zobel network measures 6.25 ohm resistive), or

b) a double cascaded 1st order Butterworth if the fall off in the woofer's response is regarded as a second inductance working into a resistance load.

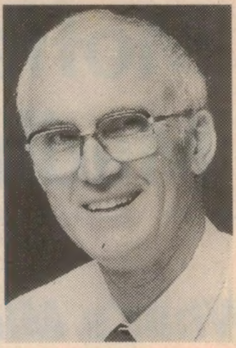
One cannot help wondering, if L-R being the "flavour of the year" baptism of a crossover (simply arrived at by trial and error for optimum performance at minimum cost) helps sales. Such invalid descriptions will certainly confuse many of your readers.

It may be worthy of note in general, that whilst the L-R is certainly an improvement on the traditional 2nd order Butterworth with has a 3dB peak at the crossover frequency if correctly phased, the former has nothing to offer above the 'Offset 2nd Order Butterworth' (-3dB frequencies of the LP and HP sections separated by 2/3 octave (1.59) symmetrically around the desired crossover frequency) I published in the Journal of Electrical and Electronic Engineering, Australia, September 1981 issue. The phase response of the two is near identical, but the 'Offset B2' has a marginally steeper attenuation slope (0.8dB at one octave from fx, and 3.0dB at two octaves away).

P. Gonda,
Linden Park, SA.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



A new era in home video is looming over the horizon...

In this issue you'll find two separate reports on the release of the first prototype DVD (digital video disc) players, at the Las Vegas Consumer Electronics Show. Silicon Valley Newsletter has a brief report, which was originally all we expected to have for you this month. However Louis Challis visited the CES himself, and was so impressed with what he saw there that as soon as he got back (just before we went to press), he 'burned the midnight oil' to provide us with a more comprehensive coverage of this important development.

And make no mistake, DVD is without doubt an extremely important development — one that will almost certainly provide the successor to existing CD and laserdisc technology within the next couple of years, and probably eclipse VCR technology as well before the turn of the century. That's clear from the way so many of the major firms have rushed to produce prototype players, when the DVD standards were only agreed upon late last year.

But why is DVD so important? Well, consider just the more salient aspects of its performance as a video delivery medium. Just one single-layer DVD disc the same diameter as an existing audio CD can store a movie of up to 133 minutes in length, with MPEG-2 picture quality which is a big improvement not only on VHS-level VCRs, but also on the broadcast reception we get on our current TV receivers. In fact it delivers images with 720 pixels per line — described as 'closely approaching an original D-1 studio master'.

The sound accompanying this studio-quality video can be either MPEG Musicam or Dolby AC-3 5.1-channel digital surround, in either case offering all channels of full CD quality or better. And a two-layer disc can double the playing time to well over four hours, with no interruptions!

Quite apart from its potential for delivering extremely high quality video, DVD also has the potential for a revolution in music and data storage. For example a single-layer DVD can store 4.7GB (gigabytes) of data, seven times the capacity of a current CD-ROM, and with two layers this increases to 8.5GB. Similarly for music recording there's the ability to store up to six hours of surround sound, of superb 'super CD' quality — using say 24-bit sampling at double the current 44kHz rate.

Small wonder, then, that already many people believe DVD will be the optical storage medium for the next 10-15 years...

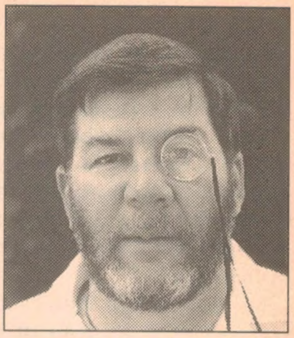
Actually I believe it's likely to have even greater impact than this, before very long. When the first DVD players and software reach the market (in the US, this is expected before the end of the year), a lot of people are inevitably going to become dissatisfied with the very modest picture quality delivered by their VCR — and also by many Pay TV providers.

I've commented here before on the way our fledgling Pay TV industry seems to be ignoring the potential to deliver improved video and sound quality — presumably in the belief that most subscribers won't realise they're being short changed. I suspect that when DVD arrives and shows consumers just what CAN be achieved, Pay TV service and programme providers will suddenly be forced to lift their game...

Jim Rowe

Moffat's Madhouse...

by TOM MOFFAT



What's Microsoft on about?

Today let's munch into some good juicy gossip. It's all about a near neighbour of mine, just down the road and over the water a bit — an outfit called Microsoft. My current place of residence, Port Townsend, Washington is 72km as the pelican flies from Microsoft's world headquarters near Seattle.

We are well within Microsoft's sphere of influence. Microsoft, along with Boeing, dominates the economy of the whole Puget Sound area, not just Seattle.

As this is being written, Boeing is nearly three months into a machinists' strike that has badly disrupted the plant's production. Now Boeing is unable to promise a delivery date for planes, just at the time when its innovative 777 model is due to hit the market. Orders are being lost, or at least delayed, and families of workers are starting to suffer badly.

With Boeing off the air, Microsoft takes on an even more important role in the economy of the Pacific Northwest. So Microsoft is being carefully watched by the media. And what the media sees is a Microsoft that's like one of those volatile mountains around here — an active volcano always threatening a major eruption. It's an eruption that would send tentacles of magma out in every direction, engulfing everything in their path.

Every now and then Microsoft seethes and burbles, and then vents some steam which shakes financial markets to their foundations. Just last night Microsoft let off a blast reported instantly on radio news.

It seems Microsoft is discussing a merger with America's giant NBC television network. The figure mentioned — FOUR BILLION DOLLARS, would give Microsoft a 49% interest in NBC. That's big bucks — four times Bill Gates' personal fortune.

Some analysts believe that it might not go that far; perhaps Microsoft and NBC will share technologies, allowing such things as TV quiz shows in which viewers participate with their home computers. But whatever happens, it will be a 'big deal'.

Nothing really surprises any more. At this time last year there was a story doing the rounds that Microsoft had launched a takeover bid for the Roman Catholic Church. The story was intended as a harmless spoof, but Microsoft being Microsoft, the report was taken seriously and reported in some highly reputable newspapers. Such is the power of the slumbering volcano.

The most public and long-running squabble (all of a week now...) is a stoush between Microsoft and Netscape, the supplier of the popular Internet World Wide Web browser software. Microsoft has decided it wants to be a big player on the Internet, and Netscape is already firmly entrenched.

Financial commentators are now saying that Microsoft isn't just out to beat Netscape, they are trying to crush them into the ground — drive their share price so low that Netscape either goes bust, or gets taken over by Microsoft.

Consider this scene from within the corridors of power, the executive lunchroom: Microsoft Treasurer Greg Maffei walks up to fellow executive Paul Maritz, and says "Netscape's down $30". Maritz stops chewing, slowly raises his eyebrows, and says, "Mmm! Goood!" But another colleague three seats away chips in: "That's not quite enough..."

This little encounter was reported in the Seattle Times, under the front-page headline 'Microsoft plays hardball'. What a development, eh?

When I first heard the name Microsoft I thought it was a brand of toilet paper. But hardball it is. Microsoft's latest weapon to squash Netscape is a price war between Web browsers. Microsoft has cut the price of its software to $0.00 — in other words, they are giving it away. This sounded too good to be true, and since I'd been getting the grumps lately about Netscape's performance on my laptop, I hopped onto Microsoft's Web site to grab their new freeby.

But guess what? It only works with Windows 95. And I don't have Windows 95 — and probably never will, since there's no way it will fit on my computer. And there's no way I will be buying a new computer, just to run Windows 95 and get my new Web browser for free.

I have been conducting my own market research — a display of Windows 95 packages in a Port Townsend computer shop. I've been told that these items haven't been real hot sellers, and my latest check revealed that the boxes nearest the window have begun to fade from the sun. Could it be that, despite all that hype last August, Win95 hasn't taken the world by storm after all? Maybe the free software is to push up Win95, rather than to pull down Netscape...

It's a very trendy thing nowadays to pick on Microsoft. Maybe it's the tall poppy syndrome. Microsoft has been very, very successful, and its joint founder and CEO Bill Gates is said to be the world's richest man. But all in all, Microsoft has been a good citizen in our area; they provide a lot of employment and they help a lot of charities. They are good neighbours to have around. If for some reason Microsoft decided to move to Silicon Valley or somewhere, the Seattle area would be absolutely devastated.

But what drives Microsoft? I mean, Bill Gates is loaded — why does he want even more money? I suspect it's much the same situation that faced the founders of Apple Computer, Steve Jobs and Steve Wozniac. They brought in big business executives to run the show, and the executives turned their show into big business. Jobs and Wozniac were very rich, but they were not moguls; they remained the techies.

As an aside to this, you've probably heard by now that Jobs has hit the jackpot again, this time with a computer animation company named Pixar. This company is responsible for the marvellous animation in the film *Toy Story*, in which each and every frame of the picture has 1.6 million pixels. Jobs has proved himself yet again to be a pretty brilliant guy when it comes to the nuts and bolts of computer graphics, and he deserves every success.

Back to Bill Gates. What would you do if you were in his shoes — richest man in the world, no real need to ever work again, still on the right side of 40? I know what I'd do — I'd be out of that Microsoft place so fast it would make your head swim, but not far. This part of the world is disgustingly beautiful; it's a land of mountains and snow and forests of spruce and maple, and lovely deserted beaches.

Bill Gates could range out say 100km in any direction, pick his dream spot, build his mansion, and live happily ever after. Except that he probably couldn't live without Microsoft. Maybe he could do a Dick Smith and get a helicopter, so he could flap into the city once a week or so just to keep his hand in.

Actually there are many Microsoft people who have tossed in their full-time jobs after a few years and built their dream homes in the woods. I've met quite a few of them, and they seem to have a love-hate relationship with the company. The love part is because during their time there, they made an awful lot of money. Workers who become full-time staff, as opposed to casual contractors, usually end up with shares in the company, and that's big bikkies.

The hate part stems from the way work is conducted in a pressure-cooker setting. Many leave because they're just burnt out. I met one fellow who lives at Port Ludlow, a ritzy retirement area about 30km south of Port Townsend. This man's only comment was that he lives within 'mortar range' of the Microsoft campus, a situation he finds oddly comforting.

So what's it like to work at Microsoft? Hectic, according to those insiders who are now outsiders. 'Crisis driven' is one term used to describe the atmosphere there. The project in hand was always due yesterday, and now they're working tomorrow to try to fix it today... The whole place runs on nervous energy, emitted by young techno-trendoids with pony tails and designer-grunge work wear. I guess the operative word here is young. Age-challenged has-been hackers like me would burn out before navigating the length of the foyer.

Microsoft seems to keep this energy flowing by pitting work teams against each other, so everything takes place in an atmosphere of intense competition. It's always THIS team against THAT team, to see who can finish their project soonest, and cheapest. And it is always a team; with the size of modern software, Microsoft's projects are always too big for one person to take on as a labour of love, like they did in the old days.

Other competition, and even friction, seems to develop between two distinct groups within Microsoft — the full-time employees, the ones with the share options and health insurance plans, and the contractors. The contractors make an awful lot of money very quickly, but they could be on the street by tomorrow, or at least whenever their particular project is finished.

This causes a certain amount of jealousy among the regular employees who see the contractors driving around in their BMW's. But the full-timers conveniently forget about those nice Microsoft shares they are stashing away, and the fact that they probably have the closest thing to a 'permanent' job in the modern workforce.

Another comment I've often heard is that there is no 'patch' one can call one's own, within the workplace. One girl I read of complained about the uniform gray corridors, all lined with tiny cubicles. Microsoft is not unique in this regard; I have seen software houses in Australia laid out this way. They call them 'cells', and these are the stalls where programmers do their work.

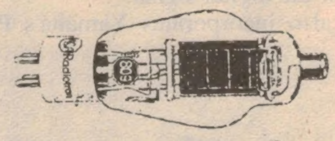
According to the ex-Microsoft girl, workers are routinely shifted from cell to cell for no apparent good reason. Boxes are stacked outside doors, indicating someone is just moving out or someone else is just moving in. It probably doesn't make much difference which cell you work in, since all their computers would be networked together anyhow.

When I worked for my last big employer, a TV station newsroom, I had my own desk in my own corner, with my own chair and my own telephone and my own typewriter (that shows how long ago it was...). That was my patch, and woe betide any young whipper-snapper caught sitting in my chair when I came into the room. Seriously, it made a big difference to overall contentment, and with it the efficiency with which the stories flowed from the typewriter.

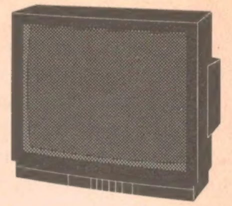
Nowadays my office is a laptop computer, so I don't have a permanent work 'place'. But I still know that all my work 'stuff' is safely there with me, no matter where I am physically sitting. Yes, a real office and desk might be better, but one learns to live with what one has.

Maybe the best thing Microsoft could do would be to find some way to make their employees, both permanent and contract, feel at 'home'. Is it really that necessary to keep them moving around?

Or maybe — if they feel at home they feel secure, and if they feel secure they become complacent. And if they become complacent, maybe they'll spend too much time relaxing and looking out the windows at those lovely woods, instead of striking a blow for Mother Microsoft. ❖



What's New in VIDEO and AUDIO



Five disc CD changers from Yamaha

Yamaha Music Australia has introduced three new CD changers, incorporating a newly designed drive mechanism which for the first time allows the disc drawer to open fully, allowing removal and replacement of all five discs simultaneously.

The three models — designated CDC-755, CDC-655 and CDC-555 —also feature the company's patented PlayXchange system, which permits up to four discs to be removed and replaced while the fifth is still playing.

In addition to the improved drive mechanism and PlayXchange, Yamaha's CDC-755 incorporates the highest quality electronics and circuitry. The new changer uses the company's highly regarded S-Bit Plus digital-to-analog conversion technology to improve resolution, amplitude and timing of the digital signal.

It also incorporates Yamaha's PRO-Bit digital translation technology, which emulates the 20-bit resolution of professional recording systems. PRO-Bit produces a more accurate and musical representation in the digital domain prior to the S-Bit Plus D/A conversion.

Other features of the CDC-755 include variable volume headphone output, optical digital output, 33-key remote control keypad, synchro-start, disc intro scan, auto-off dimmer, music calender, tape edit, and peak search. It has a recommended retail price of $599.

The new CDC-655 incorporates many of the features found on the more expensive 755, and for the first time at a $499 price point, features 10 key front panel. Digital to analog conversion is performed by Yamaha's high precision S-Bit technology.

Other features of the CDC-655 include variable output, optical digital output, tape edit, peak search, synchro-start, disc into scan, three level display dimmer, music calender, and 33 key remote control.

High end CD player from Sony

Sony's new high-end CD player, the CDP-XA5ES, is a departure from the norm in its approach to achieving the goal of musical transparency. A new D/A converter and digital filter are combined with various means of reducing vibration, a major cause of sound degradation. The result is a player that, according to Stephen Krinks, Sony Australia's Audio Products Specialist, reaches new levels of musical expression.

One of these development is the Fixed Pickup Mechanism, a new approach to laser pickup design. Instead of a lightweight laser assembly moving across the disc, picking up vibration on the way, it is the heavy disc assembly that moves across the stationary laser pickup. A solid brass stabiliser sits on top of the disc to further damp vibration. The laser is now able to read the disc more accurately, with the need for constant focus adjustment eliminated.

Another advanced feature offered by the CDP-XA5ES is the Current Pulse D/A Conversion System.

Instead of using conventional voltage pulses in the conversion process, it uses a current pulse to eliminate irregularities caused by voltage fluctuations. This is claimed to provide playback far surpassing that of traditional D/A converters,

Mini hifi has 'Dynamic Drive'

Panasonic has launched a new mini hifi component system (SC-CH73) with Dynamic Drive speakers, which are claimed to deliver a powerful rich bass sound while retaining the compact size of a mini system. It has been difficult up until now to reproduce a bass sound with warmth and depth in a mini hifi system, but Panasonic says the development of its dynamic drive speaker has made this possible.

The new system also has a three CD changer which allows the user to enjoy continuous music by playing one disc while the other two are being changed. Panasonic's 'Digital Servo' plus MASH 1-bit technology ensures a high standard of sound reproduction.

Output rating of the SC-CH73 is 83W RMS, and includes four preset sound equaliser patterns (Hall, Heavy, Soft and Clear) plus a surround mode. To further enhance

the sound it includes V-Bass circuitry for natural deep bass. The system has a full function remote control, double auto-reverse tape deck, FM/AM stereo synthesiser tuner, easy edit function and three timer functions (Rec/Play/Sleep). It has an RRP of $999.

with exceptionally accurate bass response in particular.

Also a new Full Feed-forward Digital Filter uses an arithmetic block to transmit data which was previously rounded to the nearest whole number.

Other features of the CDP-XA5ES include custom file and editing capabilities, optical and coaxial digital outputs and unique round-core toroidal transformers in both the digital and audio sections, which offer superior electromagnetic characteristics and minimal magnetic flux leakage.

'DIVA Wide' CTV from Mitsubishi

Mitsubishi Electric's first widescreen colour television, DIVA Wide, gives TV viewers the pleasure of a cinema-like picture, and also incorporates AI Fuzzy Logic' circuitry for improved picture quality — plus 'Auto Turn' to allow the viewer to adjust the viewing angle of their TV.

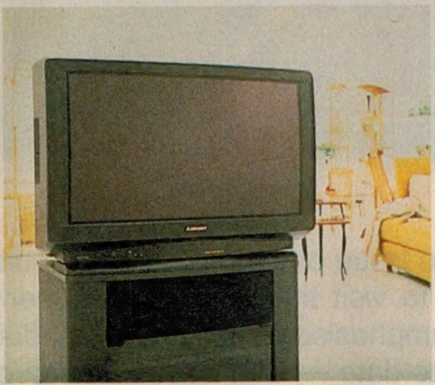
The model also has Pro Logic Sound and four extension speakers for consumers who wish to achieve true home theatre. Six other digital surround sound modes — Pro Logic Phantom, Theatre, Concert Hall, Stadium, Disco and Pseudo Stereo — add to the TV's realism.

The matching stand has a centre channel speaker and a built-in woofer as well as space to accommodate a VCR or laser disc player.

The DIVA Wide also features eight picture modes, so viewers can manipulate 4:3 broadcast material to fit the screen as best suits the programme. A feature called 'picture-out-picture (POP), allows the 16:9 screen to be broken down into a 4:3 screen with three even boxes in the remaining screen area. Viewers can then watch the main screen plus three other broadcast sources (from other TV channels, audio visual or laser disc).

They can then alternate between sources, changing which one appears on the main screen, the extra pictures appear next to the main one, not within it as is the case with picture-in-picture (PIP).

With two TV tuners, the Mitsubishi



set offers both POP and PIP, and has an RRP of $6999.

Kenwood Pro-Logic receiver offers value

Kenwood's new KR-V8070 surround sound receiver is designed to be an integral part of contemporary home theatre lifestyles.

A prominent blue fluorescent display alongside large motorised volume and input selector controls are the characteristic features of the stylish front panel. In addition S-video, video composite and left/right audio input channels are also located on the front panels.

Most of the controls can be addressed via the remote control and on-screen menu system. The universal remote is the 'pre-set' type and can control other Kenwood components such as laser disc players, CD players and tuners etc.

Five channels of amplification deliver 120 watts in stereo mode, or 100 watts for front (left, centre, right) channels and 50 watts to the rear surround channels in theatre mode. As a home theatre system the KR-V8070 offers Dolby Pro-Logic, Dolby 3 stereo, and new DSP-Logic Surround modes of operation.

The KR-V8070 is covered by a two year parts and labour warranty, and has an RRP of $1299.

The CDP-XA5ES has a suggested retail price of $1999.

Valve amps from China

Zeng Dejan is one of China's leading tube designers and heads the Shenzhen Valve Audio Lab, in the Shenzhen province of mainland China. Aware of the prevailing attitudes toward tube equipment, Dejan designs and develops amplifiers for the burgeoning DIY market, and produces factory assembled esoteric tube designs in both single ended (SE) and push-pull (PP) designs.

The SVAL product line-up comprises a number of tube stereo power amplifiers, mono-power amplifiers, a pre-amplifier, an integrated amplifier and a single-bit digital to analog converter.

The initial entry point is the VAA 'kit series' of six models, with a choice of KT88/6550, 300B, EL34, KT66 and 6LG6C/6P3P tubes in the output. Offering output power from 12 watts to 50 watts, the VAA kit range is based on and looks similar to the famous Dunaco ST-70 models. SVAL also manufacture a VAA-L1 line stage pre-amp that will partner any of the kit power amplifiers.

The MP range comprises a fully factory assembled range of tube power amplifiers, a pre-amplifier and an integrated amplifier. The power amp line-up comprises the MP-120S, a 60 watt/channel amplifier employing the 6550/KIT88, the MP-300BS 25 watt/channel amplifier employing the 300B, the MP-70MKIIS a 40 watt/channel amplifier employing the EL34 and the MP-2A3S 16 watt/channel amplifier employing the 2A3. The MP-302 integrated amplifier employs six EL84/6BQ5s pentodes in parallel push-pull per channel, offering 35 watts RMS.

The SVAL tube components start from $1500 and are covered by a 12 month warranty. For further information contact Josef Riediger on (02) 708 4388. ❖

DVD STARS AT THE EXCITING 1996 WINTER CES

Just as we were about to send this issue off to the printers, Louis Challis arrived back from a visit to the USA, where he was able to visit the Winter Consumer Electronics Show (CES) in Las Vegas. Although some reports emphasised the lower attendances at this year's Show, Louis found it one of the most exciting to date — and was most impressed by the first demonstrations of Digital Video Disc (DVD). Here's part one of his first-hand report.

Each year the Winter CES in Las Vegas grows bigger and brighter, with more manufacturers opting to release their latest and greatest product lines at the CES.

Whilst the hordes of retail buyers who are attracted to the show are unquestionably important, it's the national and international journalists who provide the means of disseminating the information to the world at large. The number of journalists attracted increase each year, and this year I noted with interest a television crew from Russia busily recording and filming the proceedings.

Most marketing companies now go out of their way to assist journalists. This eases their time-consuming task of collecting and absorbing the monumental numbers of PR releases which are available in the press room. The volume (and weight) of PR material collected by the average journalist may range from as little as 10kg to as much as 60kg, depending on how much material they are prepared to carry or ship back to their office.

One unexpected, but nonetheless useful bonus now observable is the extent to which some companies are prepared to assist the journalists with unsolicited favours. The best example of this was the approach taken by Motorola.

On all three days of my attendance at the CES, I was offered (and accepted) the free use of a neat new digital Motorola mobile phone. The free use of the phone was limited to local area calls. That however didn't stop me from using my Telstra telephone credit card to lodge my interstate and international telephone calls, using the appropriate 1-800 number.

Other more conservative marketing companies and their PR firms are equally aggressive when organising special seminars for the press. I noted that with few exceptions, a valuable door prize was offered to ensure maximum possible attendance at the press release.

The total number of attendees at this year's CES was only marginally above 80,000. Last year there were close to 100,000 attendees, and the 20% drop in visitors is obviously significant. Some proportion of that reduction must be attributed to the US Government's prolonged shutdown, which resulted in no new visas being issued by American Consulates in Europe and Asia prior to the CES.

Whilst the local press highlighted the lower number of attendees, I confess I was oblivious to the reduction. My experience was that the queues for the most important and critical displays were longer and considerably slower than ever before, and a press pass did *not* expedite entry.

DVD fanfare

Before the CES commenced, a number of major American newspapers were gleefully describing the imminent release of the new DVD technology. As you may know, DVD stands for Digital Video Discs, and there were at least 13 major firms displaying either working prototypes, or attractive mockups of their first generation of DVD players.

Toshiba's literature at the show boldly claimed 'Toshiba Did It', a statement that may be true. As I recall, the Toshiba/Time Warner strategic partnership (hardware development and software marketing) led to the cross-industry alliance that established and accepted the unified DVD standard. The competing Philips/Sony system was dropped in preference to the Toshiba system. The acceptance of the Toshiba system came as a result of its clear superiority in almost every department. But in reality Toshiba's DVD system is both evolutionary and revolutionary, and many of the more basic principles on which it is based were soundly developed by Philips and Sony over a decade ago.

Toshiba went even further, and introduced a number of exciting improvements. Those improvements impinge on DVD as well as a multitude of related data systems, the most significant of which will

be the CD-ROM and the CD-I (interactive CDs). CDV (digital video) discs as we currently know them are likely to suffer an early demise.

The Toshiba literature reveals that they employed more than 100 engineers during an intensive two-year period to develop their system. The unified DVD standard defines a disc that maintains the overall dimensions, so that it looks and feels like the current generation of compact discs. The diameter of the DVD's disc is the same (at 120mm), as is the thickness, at 1.2mm. The new DVD disc players will be without exception backward compatible. That means you will be able to play your current CDs, photo CDs, and even CD-Is on your new DVD player. The DVD player will automatically recognise what type of disc is being played and adjust the laser to accommodate the disc's specific requirements.

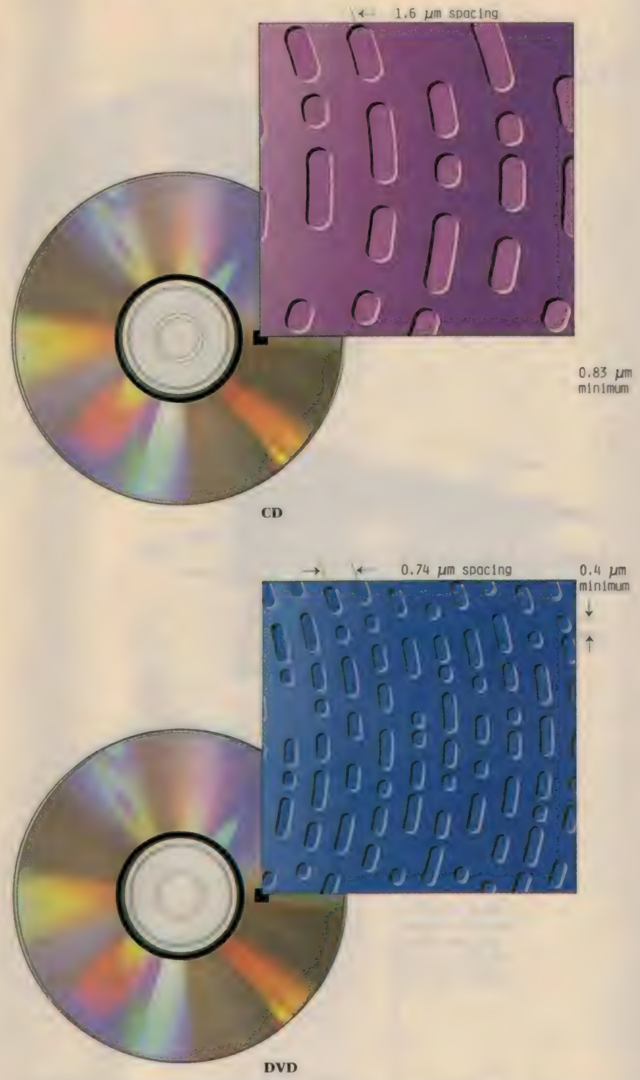
One extremely critical attribute of the new DVD discs is that they can be replicated using the existing CD production facilities. This is because the manufacturing techniques of the two discs are almost identical. There are however numerous important and dramatic differences between the two formats. In like manner, the potential range of software which will be accommodated by DVD is so exciting that all pre-conceptions on how audio or video software can, or will be handled, are now irrevocably altered.

Two layer format

The DVD discs will be manufactured with either a single layer (like current CDs) or with two layers of data. Each of those layers is provided in a 0.6mm thick primary layer. Each layer holds seven times the 680-megabyte data capacity of a conventional CD.

The most revolutionary difference between the DVD and a CD is that the two separate layers of data on a DVD are read from the same side of the disc. A dual layer DVD can store 8.5 gigabytes (GB) of data using the two 0.6mm thick substrates, which are bonded together during the final stages of disc assembly. The single-sided dual disc incorporates a new semi-transmissive film which coats the layer of pits closest to the laser pickup. When reading the deeper layer of data, the laser actually reads *through* the semi-transmissive layer. This aspect of the Toshiba system was originally rejected by Philips and Sony. It appears that they only accepted the Toshiba system following critical listening and viewing observations to assess the practicality of the system.

Obviously, the ability to read the innermost layer of data involves a change of focus for the laser, coupled with a simultaneous change in the wavelength of the beam from 635nm (nanometres) to 650nm. The reference data rate for the DVD is nominally 8.864 megabits/second. When compared with the video content of a conventional laserdisc, the data capacity of the DVD falls well short of its erstwhile rival. Notwithstanding, there is significant redundant data on all conventional video discs, and Philips, with the support of Sony, spent considerable time developing the MPEG 1 and subsequently the MPEG 2 video data compression systems.



Compared with conventional CDs, DVD uses smaller pits and more closely spaced tracks. The result is a significant increase in data density, and hence data capacity — 4.7 gigabytes per layer, compared with 680 megabytes.

The shortfall in digital capacity of the DVD is accommodated by its adoption of the MPEG 2 system. Although I carefully scrutinised each DVD video demonstration, I did not observe any trace of visual aberration or related deterioration in picture quality.

The most exciting aspect of the new generation of DVDs is their ability to provide up to 260 minutes of full motion video (133 minutes per layer), with a clarity and sharpness which is significantly better than anything you have ever seen on your TV set. The interface between reading the end of the first layer of data and the transfer to the second is seamless, and you are totally unaware of it. Toshiba's demonstration provided the opportunity to time the change-over to a fraction of a second, and even then, I could not identify the change.

DVD apparently creates a myriad of opportunities for movie producers and multimedia software providers, to incorporate unusual 'extra features'. The producers now have the ability to incorporate multiple story lines on one DVD disc, thereby allowing the viewer to determine the outcome of the plot in a truly interactive way. Although I was impressed by the first generation CD-I players, the capabilities of the DVD system spells the impending doom of CD-I, as anything that CD-I can do, DVD will perform and execute substantially better.

The Toshiba DVD players, and those offered by a number of other firms, will incorporate built-in parental control systems. A parent will thus be able to select the rating versions which a child may automatically view and access, where multiple versions are provided on the same DVD disc. How that pans out in the end remains to be seen; however it is a progressive pro-active approach to a long standing problem.

AC-3 Digital Surround

Each demonstration of DVD presented at the CES used NTSC format, supplemented by the Dolby AC-3 Digital Surround system. Most readers would be unaware that the Dolby AC-3 surround sound system provides six discrete audio channels. These six channels envelope you in the most realistic sound you have ever experienced.

Actually although the AC-3 surround sound system is frequently described as being six channels, there are in fact only

five full channels (left, centre, and right for the front, with left and right rear surround channels) — each of which provides a true 3Hz to 20kHz bandwidth. The sixth channel is described as the 'Low Frequency Effects Channel' and is only used infrequently, as it contains additional bass information to maximise the impact of scenes such as explosions, crashes, etc. Because the sixth channel has only a limited frequency response (3Hz to 120Hz), it is generally referred to as the '.1' channel, and consequently Dolby describes the AC-3 system as having '5.1' channels.

All six channels in the Dolby Surround AC-3 system are digital. As a result they can be transferred with no loss of performance from the producer's original mixing console right through to the software in which they are incorporated, and which you will ultimately play in your home playback system.

What I wasn't really prepared for were the many other attributes of the DVD system. Those attributes include the ability to incorporate subtitles in up to 32 languages, the built-in capability of providing eight different (separate) sound tracks in eight different languages, which may be recorded on the same disc. The sound track options that will be provided with a mandatory NTSC video display are either two channels of linear PCM and two additional channels where required, or the 5.1 channels of Dolby AC-3, as selected by the software producer.

Enormous potential

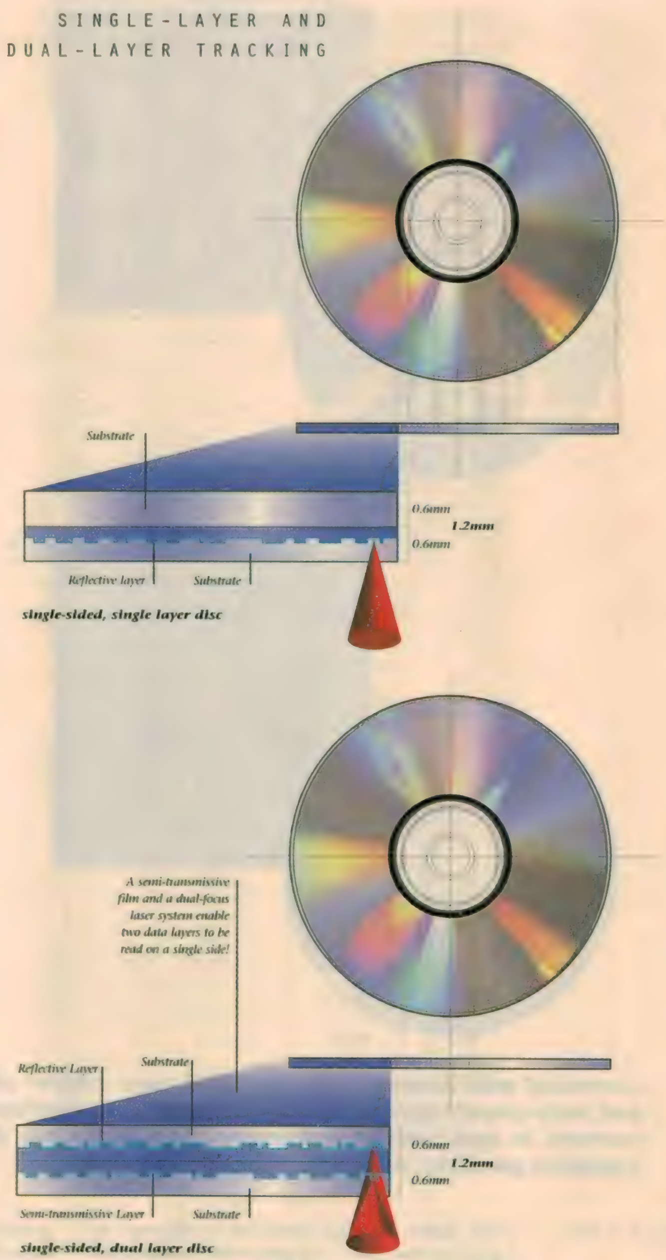
As I looked and listened to each sequential demonstration (in the demonstration room of each major equipment manufacturer), I must admit I was bemused by the dramatic increase in potential of the DVD system when compared with any of its predecessors. For example I was surprised to discover that the DVD capabilities include provision for switching video formats from the conventional 4x3 'pan and scan', to the letterbox format (which is being promoted so ably by Philips International).

As if that weren't enough, I discovered that the format can also provide for a 16x9 widescreen format, thereby facilitating the display of special wide-screen mode for the most advanced 16x9 television sets. Of course, in order to use that capability, the disc manufacturer has to have provided more than one of those options (or alternatively all three options), on the specific disc being viewed.

In order to appreciate how a DVD achieves its dramatic increase in capacity, it is appropriate to compare a magnified view of the surface of a conventional CD with that of a DVD. As you will observe, the minimum pit length in a conventional CD is 0.83um with a 1.6um spacing between tracks. By contrast, the DVD uses a 0.4um minimum pit length, with a 0.74um spacing between tracks.

In order to accommodate this demanding requirement, each DVD's laser assembly has been refined to incorporate what is described as a 'higher numerical aperture lens'. This results in a narrower and much more tightly focused laser beam, which can focus on, and respond to the micro-miniature pits involved.

With many microscopic pits so closely aligned, the digital modulation characteristics and the equally critical error correction systems had to be optimised. The DVD uses an improved 'Reed Solomon Product Code' error correction system which is 10 times more robust than that used in the current CD system. Without that improvement in the total error correction system, you would be able to readily pick optical errors, and possibly even audible drop-outs as well.



Taken from a Sony brochure, these diagrams show how DVDs can be made with either a single layer or two layers — which doubles the disc capacity to a massive 8.5 gigabytes.

Globally compatible

Questions raised at the CES regarding whether US manufactured DVD discs would be compatible with Australian marketed DVD players were gently brushed aside, by all those to whom I posed the question. Following my return to Australia, I posed the question to George Sprague, the inimitable PR Officer of Philips International. George contacted the Philips Laboratories in Eindhoven, who provided the assurance that DVD discs manufactured in America to the NTSC standard *will* be playable on PAL-based DVD players and TV sets or monitors in Australia.

That means that you will be able to hire pre-recorded DVDs at your local video shop, and play them with the loss of a few lines at the top and bottom of your

video screen, but no significant loss of visual acuity.

Whilst many of the eight major marketing firms displaying their prototype DVDs also provided visual demonstrations, ably supported by Dolby AC-3 sound systems, I suspected that some of those demonstrations were not what they claimed to be. At least one of the demonstrations appeared to be using an HDTV (high definition television) system. I was convinced that another display was using semi-conventional software, suitably enhanced by the use of Farouja Line Quadruplers to show what could be achieved with software and material which is currently unavailable in the DVD format.

Another very interesting product released at the CES was the 'Wonder Tools' system from toy maker Fisher-Price and computer maker Compaq. It's designed primarily for children between the ages of 3 and 7.

Sony alone was already discussing future rewritable (recordable) DVDs. The research and development of such discs is well advanced, but I fear it will be at least one, and more likely two years before the first experimental recordable DVDs are likely to be displayed at the CES.

Of all the DVD displays, the most impressive were the demonstrations presented by Toshiba, as they had direct access to the best of the Time Warner software, supplemented by Dolby AC-3 5.1-channel sound tracks.

Sony, Philips and Toshiba stressed the exciting and future potential of DVD in a broad range of multimedia and computer applications. It appears that there will be a number of different variants of the DVD system. Each of those variants will offer increasingly higher storage capacities. As a result, it appears that DVD holds tremendous growth potential for data-intensive home and business applications.

Sony's 3D video

Of all of the video demonstrations at the CES, the Sony display was the most outstanding. Sony had configured a large theatrette with two separate projection TVs, and provided each attendee with a pair of red/blue glasses to provide true three dimensional video.

The results were absolutely astounding, and although I have seen many 3D films and presentations over the last 40 years, not one of those could compare with the images that the Sony system provided. The images were so realistic that I repeatedly felt I could put my hand out and touch the objects which were virtually in front of my nose.

Of course the major claim made for DVD is that the advanced digital technology enables DVD players to deliver extraordinary picture quality. For the first time, the high performance TV sets which have been available in America (and Australia) for approximately three years can now perform to their maximum capability, providing razor sharp images with richer colours, finer resolution (better than 720 pixels in the horizontal line), and extraordinary colour purity. Unlike the current generation of video recorders which frequently produce 'colour bleed' between reds and blues or reds and greens, the digital picture of the DVD avoids that problem completely.

The most frequent media question at the press releases was the likely cost of the first generation of DVD players. Based on the responses I heard, it appears that they are likely to be marketed in the USA late this year, with a typical selling price somewhere under US$700 for the premium models, and less than US$600 for entry level models.

Wonder Tools

The next most interesting development at the CES was the release of the Fisher-Price 'Compaq Wonder Tools' system. Now Fisher-Price is one of America's most renowned and successful manufacturers of children's toys. I have purchased many Fisher-Price toys for my grandchildren, but they were amongst the least likely firms that I would have expected to find at the CES. The Wonder Tool system is the first of a new family of computing products designed primarily for children aged between three and seven — and although not admitted, for possibly their parents' use as well.

The Wonder Tools Cruiser and Software is an innovative driving console with an associated CD-ROM software disc that together provide an interactive system through which preschool children can play and learn on the home PC.

The critical element is the Wonder Tools Keyboard, which uses oversized keys and a mouse. This will be backed by activity software aimed at easing the complications of learning. Fisher-Price are developing a new line of interactive software titles, which will be released through leading PC and toy retailers. The Wonder Tools Keyboard will sell for approximately US$130, and prospectively approximately $180 in Australia.

The critical element in the system is not the Compaq computer or the Wonder Tools Keyboard, but the software — which I was unable to critically evaluate.

The future selling price of the CD-ROM software was not mentioned, and the availability of cost-effective software will ultimately determine the viability of the system. The stated minimum requirements for the computer are specified as being a 486/66MHz PC, which did not conform to my expectations of an 80286 or 80386 computer being relegated to the task. The computer will operate on either Windows 3.1 or Windows 95. It will require 8MB of RAM, 5MB of free disc space, a double speed CD-ROM drive and a Sound Blaster, or a 100% compatible sound card.

A competing product released prior to the CES, and displayed on the Sony stand, is the 'Sony Playstation Game Console System'. The Sony system is clearly aimed at an older age group, with teenagers and yuppies being the primary focus. The Sony system already has a range of more than 50 titles available, which were released on January 2.

Unlike the Fisher-Price system which is designed to use an existing computer, the Sony Playstation is a stand-alone unit with its own 32-bit RISC main CPU, operating at a CPU clock frequency of 33MHz. The basic Sony Playstation is already selling in Australia for $699.

It has been designed to provide superior video and audio content to that offered by the conventional SEGA software and hardware, which is readily available throughout the world.

Plasmatron displays

Sony displayed the first of their high quality large thin Plasmatron Flat Panel Displays. The Plasmatron Flat Panels have been developed for wall mounted TV sets, or 'multimedia' screens. The Sony Plasmatron screens use Plasma

Continued on page 36

LET'S LOOK AT MONITORS

Many service technicians are inclined to steer away from professional video monitors, perhaps due to unfamiliarity. Although much of the circuitry inside them is very similar to that in domestic colour TV receivers and VCRs, there are certainly quite a few differences as well. Here's a rundown on the less familiar aspects of professional monitor operation and setup, which should take much of the mystery out of this equipment.

by BRYCE TEMPLETON

There are two areas of television broadcasting that are considered 'black arts' by the other engineering staff. These are audio maintenance and monitor maintenance. It is interesting to note that both of these are areas where it is very difficult to measure the final results; the test of your labour tends to be subjective.

In every television station or video production house, there are a large number of video monitors. These range from the lowliest domestic portable to the top of the range professional monitor, and often include such things as video walls and video projectors.

It takes a very special breed of technician to spend their lives specialising in the frequently thankless task of repairing and adjusting these units.

The maintenance of these monitors is a very labour intensive business. As a manual setup, not including any repairs required, averages about two hours, if an installation has 200 monitors, it can be seen that one person would take about two months to get around to them all.

This would be too long for monitors in critical areas, so some juggling of the service schedules would be required, as most technical directors will complain if they can see differences when all the colour monitors in a control room are displaying the same picture.

A trip to your local department store's TV display will convince you that this is a tall order!

There is a reason for this (apart from the technical directors' natural instinct to pick at technicians' work). All TV programs, regardless of their origin, are colour graded. Live and recorded studio programs are colour graded as part of the production process, while program material recorded outside the studio and films are graded as part of their post-production.

Colour grading

The reason why this colour grading is required is interesting. When movies are copied for distribution to cinemas, every care is taken to ensure that the colour in each reel matches as closely as possible. But in the distribution process, prints get damaged and sections are replaced, and when this occurs, there is often a colour difference between the old and new.

When the film is shown in a cinema, these colour changes will usually go through completely unnoticed by the audience, but if the film is shown on television, the smallest colour change will often provoke comments like "Ooh, they've gone all green!" It must have something to do with the intimacy of the small screen.

Because of this, all films are colour graded as they are transferred to video tape prior to being shown on television — or copied to VHS or laserdisc either for that matter.

Anyway, the point is that the colour grading can only be done subjectively. That is, a trained person will look at an accurately aligned monitor and make adjustments to the amount of colour (the saturation) and the tint of an object depicted on the screen.

As soon as we have the words 'trained person' and 'subjective' mentioned in the same breath, there is a recipe for disagreement. The disagreement usually centres on the reproduction of the most easily recognised colours: skin tones.

Rose tinted glasses

This brings us to a discussion of the way our eyes see colour pictures. Try this experiment. Look at the world for a minute or two with one eye covered with a piece of red cellophane. Now, remove the cellophane, and while viewing the same scene, close each eye alternately. The world when seen though the cellophane eye will be a lot greener than that seen though the normal eye.

What has happened is that your cellophane eye has 'colour corrected' itself

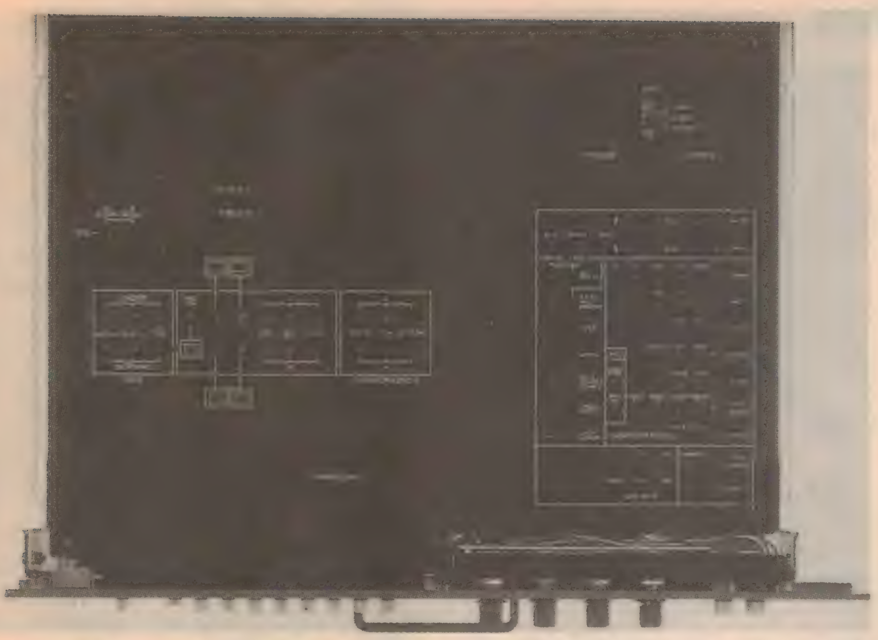


Fig.1: The secondary setup controls on a Sony BVM-1916/2016 professional monitor, in its slide-out drawer. (Courtesy Sony.)

— by taking out red — in an attempt to make its now very red world look right. So without the cellophane you see the world 'minus red', or green, when using this eye. It is interesting to note that individually, the scene through either eye looks normal; it is only when you have something to compare it with (in this case the other eye) that it looks wrongly tinted.

So which is correct, the cellophane eye or the other eye? People who wear tinted contact lenses to change their eye colour do not notice that the world has turned a baby blue after they have been wearing them for a short time. Then when they take them out, their world is 'minus baby blue' for a while.

This is why it is impossible to adjust two monitors to look the same, if they are not within sight of each other. We just can't remember subtle tints.

This 'comparing colours' was the basis of the first attempts to align colour monitors to a standard. A white card of a very precise colour was placed in a box and illuminated with a light of a very precise colour temperature, and viewed though a lens and mirror system that showed you two squares next to each other.

One square was the white card and the other was a small section (about 50mm square) of the screen of the monitor under adjustment. Thus one eye could see both the screen of the monitor and the reference, so theoretically it was possible to adjust the monitor to make the two squares the same. There was an iris to allow dimming of the light without changing the colour temperature.

There were two main problems with this system. One is that if you stare long enough at a square of light a section of your eye's retina becomes desensitised, so that if you the move the light to another section of the retina, the original square is 'stuck' for a while, causing a wrong perception of the saturation. This means that you must 'rest' your eyes every few minutes, or you will keep on adjusting forever.

The other problem is that you need one hand to hold the device, one to do the tweaking, one eye to look into the hole, and one eye to see where the tweaking knobs are. Most people's eyes can't look straight ahead and down at the same time, so you are forever finding the adjustment, looking though the device, losing the adjustment, looking down to find it again, looking back though the eyepiece, etc. And all of this is done in semi-darkness...

This phenomena of your eyes getting 'tired' or 'accustomed' to colours is a real problem for colour graders, and is sometimes alleviated by placing the monitor in a translucent plastic wall that is back lit to the correct colour temperature. This gives the operator a white reference, and a place to 'rest' his or her eyes.

The circuitry

So, what's the difference between your home TV and a precision monitor? Apart from about $15,000, there are several significant differences.

Firstly, the picture tubes come in three main grades. Grade one, the most expensive, has a resolution of around 900 lines, and few blemishes in the central area. Grade two, a bit cheaper, has

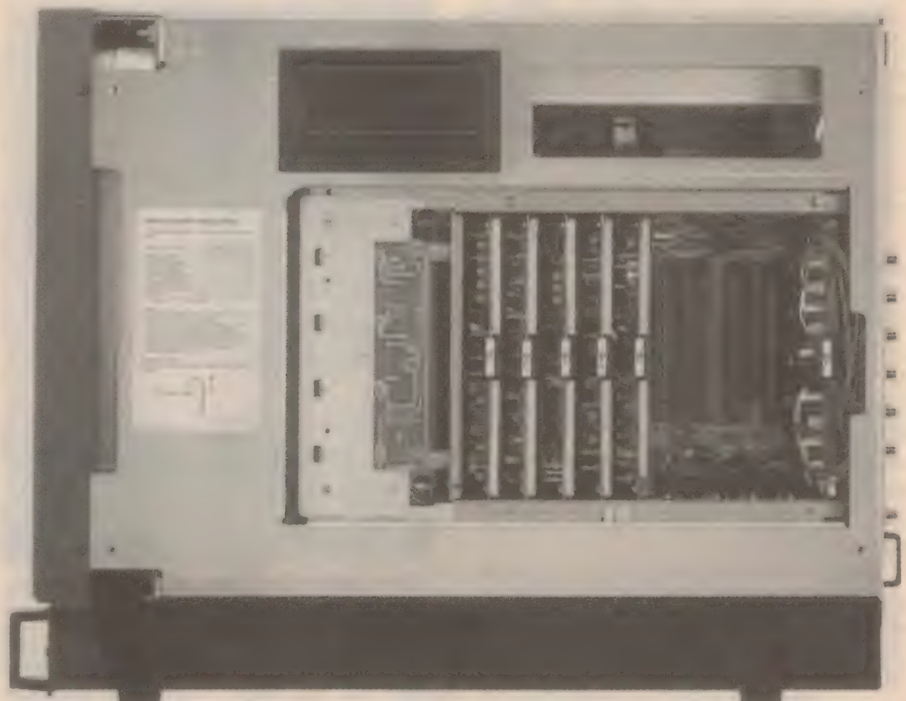


Fig.2: Many professional monitors use a modular construction, allowing rapid servicing by substituting plug-in modules. Shown here is the side of a Sony BVM-1916/2016. (Courtesy Sony.)

about 700 lines resolution and more blemishes; and grade 3, cheaper still, is 500-600 lines and still more blemishes.

The lines mentioned in these specs should not be confused with the 625 scanning lines, but are a measure of the ability of the monitor to display fine detail. For instance, if one imagines a screen with a pattern of 900 vertical lines evenly spaced over the entire viewing area, the tube with a resolution of 900 lines should allow one to make out each black-to-white transition, while on a 600-line tube this would not be possible.

Secondly the circuitry is more precise. The power supplies are always fully regulated and have sufficient capacity to work with low mains situations, such as may be encountered if the monitors are in an outside broadcast van. Great care is taken to ensure that interference from the switch-mode power supply is not visible on the screen.

Then there are the scanning circuits. These provide the best possible linearity of the picture, with adjustments for pincushioning (the curving in or out of vertical and horizontal lines at the centre of the top, bottom and sides) shown in Fig.7, and other horizontal and vertical geometry adjustments. The scanning circuitry must also be able to retain the correct linearity when the picture size is reduced, as most monitors include a switch to allow full size or under-scanned pictures where the edges of the active picture area are seen. Often this means two sets of adjustments, one for normal size, and one for reduced.

A typical secondary control panel is shown in Fig.1. This shows separate height and width controls for underscan and normal, along with separate side pincushion adjustments for each size (SIDE PIN), a top and bottom pincushion adjustment (T&B PIN), and four geometry controls that can only be described with pictures. This monitor also has horizontal and vertical linearity controls and six convergence controls.

Many newer monitors include electronically generated test patterns and 'safe area generators' which place a white outline on top of the picture to indicate the area that graphics should occupy to ensure that they will not be cut off when viewed on a domestic receiver.

(By the way, domestic receivers are always overscanned by about 5%. They are adjusted like this to be sure that the VITS (vertical interval test signals) and teletext signals, which crowd the vertical sync block nowadays, are not visible to the home viewer — most of whom seem to be intensely annoyed by them.)

Fig.3: The Sony BVM-1916/2016 pro monitor is setup automatically using this BKM-2053 sensor probe, which attaches to the centre of the CRT screen. (Courtesy Sony.)

One of the major differences between domestic and professional monitors is in the area of EHT (extra high tension) regulation. Most modern domestic receivers do not have regulated EHT supplies, but to maintain proper control of picture size and linearity, it is essential.

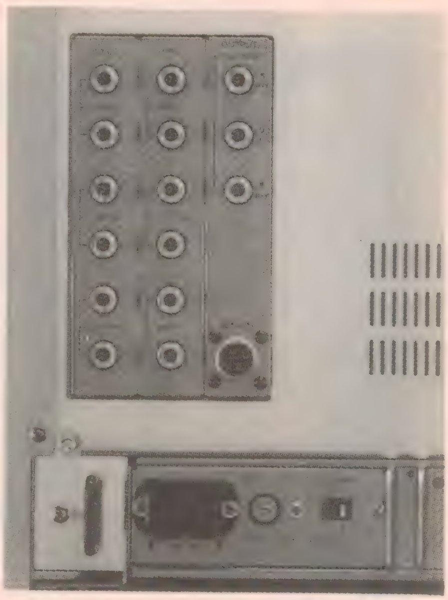


Fig.4: Most pro monitors have a wide range of inputs, and are able to accept Composite, RGB or Component video input with separate sync. They may also provide RGB or Component video outputs from the internal decoder, like the Sony monitor shown here. (Courtesy Sony.)

The problem is that variations in beam current, caused in turn by variations in picture brightness, result in the EHT voltage rising when the picture is dark and falling when the picture is bright. This means that the actual brightness of the picture is not linear compared with the signal input. So if, for instance, a sawtooth pattern is applied to the monitor input, the resulting picture should be black on the left gradually rising to full white on the right of the screen. If the EHT falls as the brightness increases, the maximum level of white will never be reached.

The EHT also greatly affects picture size. If the EHT is low, the electrons move towards the screen at a more leisurely pace, and are easier for the scanning circuits to deflect, so the picture gets bigger. The reverse happens if the EHT rises, so the picture then gets smaller. This effect can occur at a line rate, so there can be bending of vertical lines according to areas of picture brightness. A typical specification for a professional monitor would call for a maximum change in raster size of less than 1% with a change of brightness from zero to 120 NITS.

Danger: High Voltage!

Therefore the first step in setting up a pro monitor is to check and set the EHT voltage. If this is not done first off, every other adjustment will be affected. As we are dealing with big bikkies in the volts department here — around the 25kV region — great care has to be taken if the monitor's design requires that the EHT is measured directly.

One of the most important things to check is that the meter's earth lead and clip are in good condition and correctly connected. If they are not connected, or the lead is open circuit, the whole meter will rise to 25kV and may arc though the case — either to you, or to some part of the monitor where 25kV is not welcome. Whatever happens, it will not be nice.

The earth lead must not be connected to parts of the circuit that may be mains isolated with capacitors, such as input sockets. The best place is the point where the earth for the outside coating of the tube is connected (usually on the tube socket board).

Some monitors overcome this risky

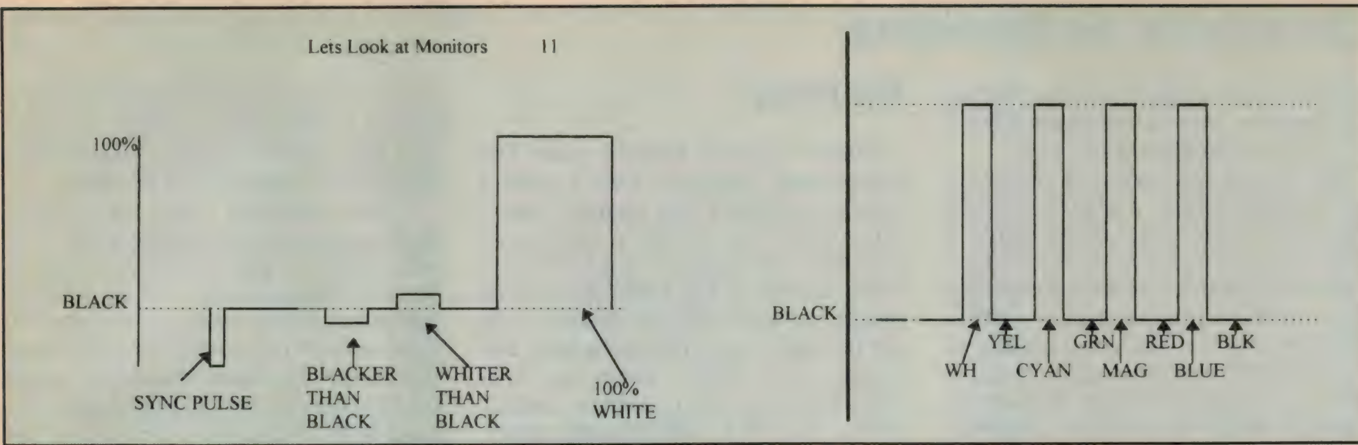


Fig.5 (left): A simplified drawing of the PLUGE test signal waveform. Fig.6 (right): A simplified drawing of the blue component of the colour bar test signal. Adjusting the colour saturation will change the level of the blue bar, and not that of the white.

business by calibrating a low voltage point in the EHT regulator, so that if this voltage is say, 9.5V, then the EHT can be assumed to be 25kV.

EHT regulation is a subject that has as many solutions as there are manufacturers. The simplest and one of the most effective is to simply 'sniff off' a sample of the EHT with a voltage divider and use this as the error voltage of a regulator, which in turn is feeding the EHT generator.

Since we require our sample to be about 20V, Ohms law tells us that that the 'top' resistor of our divider will be in the hundred megohms region, and capable of withstanding more than 25kV, if the bottom one is 100kΩ or so (in order not to waste too much of our EHT current in the divider). This system works, but it usually complicates the design of the monitor by requiring a lot of space around the 100MΩ resistor to avoid flashovers. Often the EHT generation must be separated from the line scan function, to avoid scan size problems when the EHT regulator wants more current.

Another method is to monitor the EHT and line scan current by placing a low value resistor in the 'earthy' end of the transformer and, through a complicated circuit that takes into account the scanning current required and the picture brightness at every part of the line scan, it works out what the EHT current should be, and adjusts a regulator accordingly.

Part of the EHT regulation is frequently an overvoltage detector that monitors the EHT voltage and, if it rises above its design figure, shuts down the monitor. This prevents damage to the monitor though flashovers, and also protects the operator from excessive generation of X rays. Over driving protection, to prevent excessive beam current in the CRT, is also a common inclusion. Excessively high beam currents can cause CRT damage though burns on the screen and overheating of the shadow mask.

Inputs and decoding

Other differences between domestic and pro monitors include such things as higher power and more linear video amplifiers, and accurate 75Ω inputs with 'loop through' facilities. These accept Composite video, RGB, Component and external sync signals.

A composite signal is one coded as PAL (or NTSC); RGB keeps the red, green and blue signals separate; while a Component signal is made up of the Y signal (the luminance or black and white part of the signal) and the chroma or colour part as R-Y and B-Y, or what is left when the red or blue signal is subtracted from the luminance signal. A composite signal only requires one cable, while RGB and Component require three for the picture, and one for sync, if this is separate.

Outputs are often provided to drive waveform monitors and vectorscopes, so ensuring that the same picture appears on the waveform monitor as is on the monitor screen. An input panel is shown in Fig.4.

The PAL decoder is usually of higher quality in pro monitors, in order to reduce artefacts on the screen caused by inaccurate decoding. In fact, a precision PAL decoder can cost thousands of dollars on its own.

Another difference between domestic and pro monitors, and perhaps the most obvious, is in construction. In pro monitors all the setup controls are accessible from the front, usually in a drawer under the picture tube. This is required because when they are mounted in a rack it is impractical to work from the rear. Pro monitors are almost always modular in construction, so that faults can be quickly repaired with board swaps, and the fault fixed in the comfort of one's luxurious laboratory. Fig.2 shows this type of construction.

The chassis and case are often constructed of steel to afford some measure of magnetic shielding. Since many monitors may be mounted in close proximity to each other, interference between the scans can be a problem if the monitors are not all running from the same synchronising source.

Normally pro monitors must fit into a 19" rack, so this limits the picture size to about 52cm. But larger sizes, including 16:9 aspect ratio monitors are available.

Self-converging tubes

How does the modern TV station ensure that their monitors will all look the same?

Two new innovations have come about in recent years that have made the semi- and fully-automatic alignment of professional monitors practical.

The first is self-converging tubes. This is a marvellous invention, where all the boring interactive convergence and purity adjustments are done once in the factory when the tube is made, and never have to be done again. The yoke assembly is permanently bonded to the tube neck, and static convergence is accomplished by magnets around the neck of the tube, which are then sealed. The design of the monitor is simplified as there is no separate convergence yoke; all the required waveforms are

applied to the deflection coils. Almost all domestic and professional CRT's are self converging nowadays.

The second innovation is of course the microprocessor. Today we would not even be able to eat our porridge if there were no micro in the food chain somewhere, and the old microprocessor has come to the rescue here as well in the form of colour analysing probes, as illustrated in Fig.3. One can take one's choice of using the colour analyser to manually set up any monitor, or buying auto-setup monitors with their own probe that do it all by themselves.

In both cases, decisions have to be made regarding the white level (the maximum brightness) and the white colour temperature required. The most common standard in PAL countries is a level of 80 NITS, which is equal to 80 candelas/m^2 or 25 foot-lamberts in the old money. This level is quite low by domestic standards, and the room lighting must be subdued. A colour temperature of 6500K (also known as D6500) is common. This results in a white colour about that of copying paper — a bit different from the typical domestic setup and much less 'bluish' than a domestic black and white tube.

Having selected these criteria, the analyser probe is attached to the centre of the tube where it separates with optical filters, and then measures, the amount of the red, blue and green components of the light from a circle in the centre of the tube face of about 50mm in diameter. These values are then massaged by the computer inside the probe and displayed on an LCD readout as the colour temperature in Kelvins and the luminance value (called Y) in NITS or candelas/m^2. Generally there is also a method of showing the deviation from the chosen colour temperature, such as RGB bar graphs, or a box and dot, where the dot must fall inside the box. Most probes can also display the values according to the X-Y coordinate chart.

It should be noted that luminance (how bright) and colour temperature (what colour) are two separate measurements. The difference is demonstrated when one dims an ordinary incandescent lamp; the luminance value changes (from bright to dark), but so does the colour temperature (from white towards red). In contrast if the contrast control of a pro monitor is adjusted, the luminance value changes, but (hopefully) the colour temperature remains the same.

The set-up

Ready to colour-balance your first professional monitor? You'll need a mirror, a tweaker, the analyser and a dark room. The mirror is really only required if the monitor in question has some controls at the back. If the room cannot be darkened, an opaque cloth can be draped over the probe head and screen to prevent extraneous light from upsetting your lowlight adjustments. We will assume that any purity, convergence and EHT adjustments have been done.

The lowlight adjustments are done with a 10 to 15% signal that results in a

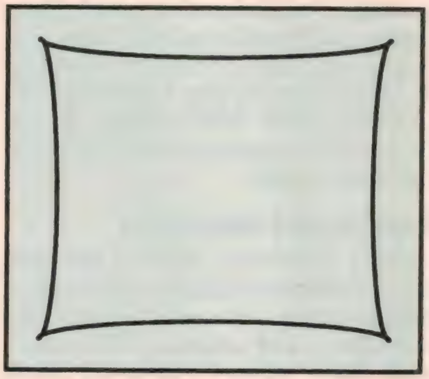


Fig.7: A drawing showing what is meant by 'pincushion' distortion.

brightness level of 1 to 3 NITS; the CRT screen controls are adjusted to make the colour temperature correct. Then a 100% white signal is applied. As 100% white is a bit of a trial for the monitor if it is over the entire screen area, it is usually electronically masked by the pattern generator to be a 100% white 'window' covering about half the screen area, with the rest black. The video amplifier gain controls are adjusted to give the correct colour temperature again, and approximately the correct level. This procedure is repeated several times until the highlights and lowlights colour temperature is correct.

A PLUGE signal is then applied. PLUGE is a signal that has a bar of slightly blacker than black, and a bar of slightly whiter than black on a black background. There is also a 100% white square. (Fig.5 shows the PLUGE signal waveform.) The brightness is then adjusted, while viewing under normal subdued light conditions, so that the blacker than black bar just disappears, while the whiter than black bar is just visible — so setting the monitor's black level. The probe and the 100% window pattern is then used to adjust the contrast (the gain of the three video amplifiers) for a white level of 80 NITS.

Colour saturation can be set with the probe using a colour bar signal and with only the blue gun turned on. This is done by measuring the level of the blue component of the white bar (on the left hand side of the screen) and adjusting the colour saturation control to make the blue bar (on the right hand side) the same light level. If the waveform of the colour bar signal is studied (Fig.6), it will be seen that these two levels are electrically the same.

This method is a bit inaccurate, as even professional CRTs rarely have even light output over the entire screen surface due to purity errors. So measuring a light level on one side of the screen and comparing it to a light level measured on the other is bound to have a small percentage of error.

The latest fully automatic monitors accomplish these same adjustments by getting the micro in the probe to talk to the micro in the monitor. The monitor then uses such things as digital to analog converters and voltage and digital controlled amplifiers to adjust the various parameters. Since the micro has infinite patience, unlike some human tweakers, the results are often superior, and it is definitely easier. As the micro can't make head or tail of a PLUGE signal, though, the black and white levels are done using accurately calibrated input signals.

Most automatic setup monitors have all the patterns they need built in, as they don't trust humans to put up the correct signals for them. Some overcome the problem of having to move the probe during the saturation adjustment by changing the horizontal sync phase. This moves the whole picture sideways, placing either the white or blue bar under the probe in the centre of the screen. Naturally, if you buy a particular maker's automatic setup monitors, you are then chained to that brand for life, as one maker's probe will not work on another maker's monitor...

Absolutely correct

The probes come in two basic types. One is the 'absolute reference' type, where the probe is calibrated to a standard in the factory and cannot be re-calibrated without the correct (read 'very expensive') equipment. The other is the 'comparative' type, where the probe is

calibrated by correctly adjusting a monitor using an absolute probe, and then storing all the required data in the comparative probe. This data is then used as the reference for subsequent alignments. This type of probe can be re-calibrated in the field if access to an absolute probe can be arranged. Comparative probes are much cheaper than absolute probes, but not as versatile.

Before we leave the magician's world of monitor maintenance, a couple of words about black and white monitors. In the last few years non-precision colour monitors have become much cheaper, to the point that they now rival high resolution black and white monitors. But B&W are still king of the 'video VU meters' for general confidence monitoring.

One thing that should be remembered is that if it is required that the white of a black and white monitor should approximately match a colour monitor, the monochrome one has to be fitted with an 'illuminant D' tube, otherwise the white will be much bluer than that of the colour monitor.

Acme Studios

How about if you want to save money when setting up your studio, and use one or two precision monitors and the rest high quality domestic? That's OK, providing you don't want to colour match them. Since the precision monitor is fitted with a professional tube — in Australia usually an EBU phosphor — the domestic will never look matched no matter how much you fiddle, as the colours will be different in the mid ranges.

You can adjust any tube for the correct colour temperature at low and high levels, but different phosphors mean different mid ranges. Domestic tubes, for instance, usually look much more 'colourful' than EBU tubes, even when the highlights and lowlights are adjusted to the same values. SMPTE phosphors, used in NTSC monitors, are different again — so a multi-standard monitor with an EBU tube would, theoretically anyway, be wrong in NTSC. This would only matter if it were compared with a real NTSC monitor.

So why not train up and enter the world of professional monitor maintenance? The main requirements are the patience of Job, a set of good earplugs for use when Technical Directors talk loudly to you, and a padded room in which you can relieve your frustration. ❖

Making music with MIDI — 1:

MIDI HARDWARE

There's currently a lot of interest in coupling up personal computers to music synthesisers and keyboards, using the MIDI system. But until you get used to the concepts and jargon, it can all be a bit intimidating. Here's the first of two articles designed to take the mystery out of MIDI, and help you get started in using it to make *your* kind of music...

by TOM MOFFAT

Back in April last year, an *EA* reader asked the Information Centre column if there was such a thing as an electronic player piano. This question pressed the 'go' button on Peter Phillips, the guy who conducts Information Centre. It seems Peter has had a long interest in mechanical music reproduction, and Editor Jim Rowe has since told me that Peter is working on a system of using a mechanical piano-playing robot to actuate a keyboard coupled to a computer. The aim is to allow the computer to produce music from the perforated paper rolls originally made for a reproducing piano.

So the answer to that reader's question was a definite Yes! There most certainly *is* a modern version of the old pianola, although it doesn't look like that big box with the pedals that sat in parlours of old. Instead the modern pianola is some kind of MIDI contraption. (MIDI stands for Musical Instrument Digital Interface.)

My own pianola is in fact a Toshiba notebook computer connected to a Korg X5 music synthesiser, and thence to a rather nice MOSFET stereo amplifier (*Electronics Australia* design, 1983 vintage) and on to a pair of elderly Leak speakers. You can fire it up with a four-hand arrangement of Scott Joplin's 'The Entertainer', sucked in from the computer's hard disk. And then if you turn it up nice and loud and sit back and close your eyes...

Is it as good as a REAL pianola? Wellll... yair, pretty close. Better, in some ways, because the piano I am listening to is a Bosendorfer concert grand, 'sampled' and hidden away in some ROMs within the synth. The real thing would be just a bit big for my lounge room, and for my wallet.

A cascade of keyboards! In this case it's a cascade of Yamaha keyboards, pictured in Tom's local music store.

I guess the downside is that, fantastic as the MIDI thing sounds, it's just not real. REAL pianolas hiss and grumble and smell funny, and they leave your legs like rubber after a long session of pedalling (who needs an exercise bike?).

However, REAL pianolas are read-only. With a MIDI setup you can record your own 'rolls'. And even if you can't play a note, you can use a kind of music-notation 'word processor' to copy in a whole piece of sheet music, albeit rather slowly. But when you then play it back, wow!

The MIDI system, of course, isn't restricted to pianos. The 'standard' system as it has evolved (known as General MIDI) gives you a choice of 128 different instruments, of which the piano is instrument number one. Other choices include a variety of saxophones, guitars, electronic and pipe organs, strings, brass, and exotic things such as a sitar. There is also a full-featured drum kit.

The General MIDI system is called General because all 128 instruments are supposed to appear in the same positions in every MIDI device that meets the 'general' spec. So no matter who manufactured the MIDI device, if it's 'GM' it should have a trombone as instrument number 58, and a soprano sax as number 65.

Some of these 'sampled' instruments could fool anybody into thinking they're real. Take for instance, instrument number 19. Many years ago, back in the 1940s and 1950s, the king of electronic instruments was the Hammond organ. Some of these were enormous, with a console containing two keyboards and a full row of foot pedals along the

bottom. There were 'drawbars' at the left of the keyboards to select the desired sound mix. Once properly set up, pressing one key would generate a whole handful of notes. So playing along with one or two fingers on each hand, any goon could make a Hammond organ sound wonderful (even me; I financed my first trip to Australia playing one of these monsters in a pub in the USA).

The sound in the Hammond organ was produced by rotating shafts and 'tone wheels', which induced magnetic pulses into nearby pickup coils. These produced the raw materials which were then mixed with the drawbars to come up with the final sound. Turning on a Hammond organ was a lot like starting a helicopter engine; you had to hold one switch for several seconds to get the tone wheels 'spun up', before engaging the main power.

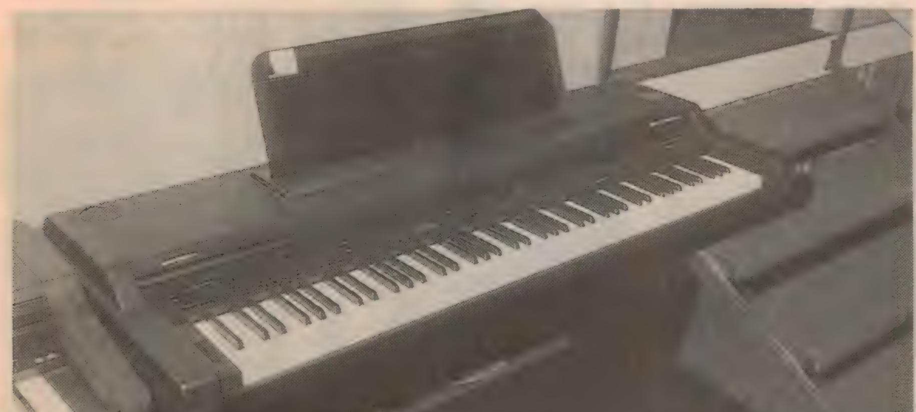
With all the mechanics and electronics crammed into a Hammond organ there was nowhere left for a decent sound system, so the speakers were almost always external — and big. And the absolute ultimate was a thing known as a *Leslie*, where the power amplifier and speakers were housed in a cabinet the size and shape of a refrigerator. Most of this was taken up by an enclosure for a big 15" bass driver.

The top section of the cabinet (the 'freezer compartment') was open and covered by grille cloth on all sizes. And behind the cloth was a speaker, on a rotating shaft that spun round and round like a garden sprinkler. This caused the organ's sound to be sprayed all around the room, with echoes and reflections continuously mixing and changing. The musician could speed up or slow down the motor at will. The result was a unique sound of the fifties that is becoming trendy again today, particularly in blues music.

McCann's Music MIDI expert Isa Zilic with MIDI sound modules from four different manufacturers.

General MIDI instrument number 19, in the Korg synthesiser at least, is a Model BX-3 Hammond organ with Leslie rotary speaker. The swirling sounds are manufactured electronically, and listening to it in stereo you can hear the notes bouncing off the walls from all directions. How did they do this? I wouldn't have a clue. All General MIDI instruments should have some kind of Hammond Organ in position 19; I wonder how many will have the Leslie speaker as well...

There is an enhancement of the General MIDI system called 'GS', introduced by Roland. Here each of the standard General MIDI instruments has several versions, or 'variations', which can be selected with some bank switching commands. It's likely GS will evolve into a further standard; many MIDI software products are already making allowances for it.



The Ultimate! A Kurzweil electronic piano, valued at a cool $7000.

How to go MIDI

There are many varieties of MIDI synthesiser, of varying levels of complexity, sound quality, and price. They come in three general physical configurations: a card that plugs into a computer, an external 'module' that connects to a computer by a cable, and a 'keyboard synth' which is a module with a set of piano keys on the front. A keyboard synth can thus make music on its own without the need to connect it to anything else (except perhaps an amplifier).

In fact you can also obtain a keyboard *minus* the synthesiser, which sends MIDI note commands out along a cable without making any sound itself. If you take one of these keyboards and connect it to a MIDI module, you then have the electrical equivalent of a proper keyboard synth, but housed in two cases.

Many keyboards can be set up without the internal connection between the keys and the module, so they act as two separate units. That way you can send the keyboard data to a computer or other device, process them, and then send them back into the module. In other words if you hooked a cable from the keyboard's MIDI OUT to its MIDI IN sockets, you'd achieve the same thing as the keyboard's internal connection (usually known as Local Control).

As for sound generation, there are currently two options. FM synthesis begins with an electronic oscillator and then uses various filtering and delay effects to try to emulate some instrument such as a piano. This is OK for starters, but rather disappointing in comparison with the second option — wavetable synthesis. Here an actual instrument is recorded via a microphone and the sound digitised, compressed, and stored in ROM. That's how the Bosendorfer piano got into the Korg.

If you own a recent IBM-PC computer, it's likely you already have a MIDI device in the form of a Sound Blaster card or similar. It seems many current computers come with a Sound Blaster card as standard, along with a CD-ROM drive. The Sound Blaster is a module in the form of a card which plugs into a slot within the computer. It's a General Midi device with the usual 128 instrument simulations, or programs.

Since most Sound Blaster cards are based on FM synthesis technology, they deliver medium sound quality. Most of

the cheaper keyboards are also FM types. The better keyboards, and virtually all external modules, are wavetable instruments.

With the introduction of the Sound Blaster 16 model, it became possible to add an outboard wavetable module known as a Wave Blaster. Other manufacturers have followed suit, and now some plug-in cards are coming out with wavetable synthesis as standard. Some still retain the connector for a Wave Blaster, and a card so equipped then contains two completely independent synthesisers.

Many of these newer cards are coming from traditional synth manufacturers, and they seem to be almost miniature copies of their most popular MIDI modules. For instance Roland has a card version of its Sound Canvas module, which is regarded as just about the best in the industry. Korg is getting into it as well, with what appears to be a card containing much the same wavetable ROMS as used in their keyboards and modules.

The latest cards have the ability to record (sample) their own wavetable entries via a microphone. I must admit I once tested one of these by belching loudly into the sampler. It was then possible to play upon the keyboard various tunes in lovely, polyphonic, melodic burps. I saw another fellow produce an interesting sampled sound by forming his mouth in the shape of an 'O', holding it near the microphone, and then bopping himself on the head. As you can see the possibilities are endless.

If you only want to listen to MIDI music, or input notes via a computer program, a module will do you fine. Many modules are duplicates of the electronics package from a particular full keyboard. For instance, the KORG 05/R module is the exact mate for the KORG X5 keyboard I am using. Their software behaviour, and sound quality, is identical. Modules range in price from below $500 up to the highest levels of the stratosphere.

If you want to play your own music, then a keyboard of some kind is a must. When a set of piano keys, perhaps five octaves wide, is placed in the same box as a MIDI module, then you have a complete keyboard synthesiser.

The whole synthesiser idea started with Mr Moog, back in the sixties. His gadget was mostly a curiosity back then, exhibited only to the technical elite of the day; that is, until a guy named Walter Carlos came along with a recording called 'Switched On Bach'. This landmark record featured growling oscillators and funny filters to produce electronic versions of Bach's well-known works. I still have a copy of that record, and nothing since has had the ability to rattle the walls and jiggle the guts as Switched On Bach.

In the late 70s another synthesiser virtuoso named Jean-Michel Jarre came along with some much more sophisticated synth recordings, recorded multi-track on tape since 16-track MIDI didn't exist back then.

The General MIDI standard still allows for these old-time noises, with a square-wave generator for instrument number 81 and a sawtooth wave for 82. But, other than that, just about everything else in a modern synthesiser is *sampled.*

Sampling, as you probably know, is the process of representing a 'real' analog sound or signal digitally. In a wavetable MIDI keyboard (or module), some human person actually plinked the piano or puffed the piccolo or tooted the trumpet, and the resulting sound was quickly digitised and stored away. In fact some sampling schemes have the instrument played at perhaps 32 different intensities. This is because something like a piano makes a totally different sound when a key is pressed gently than it does when you really whack it.

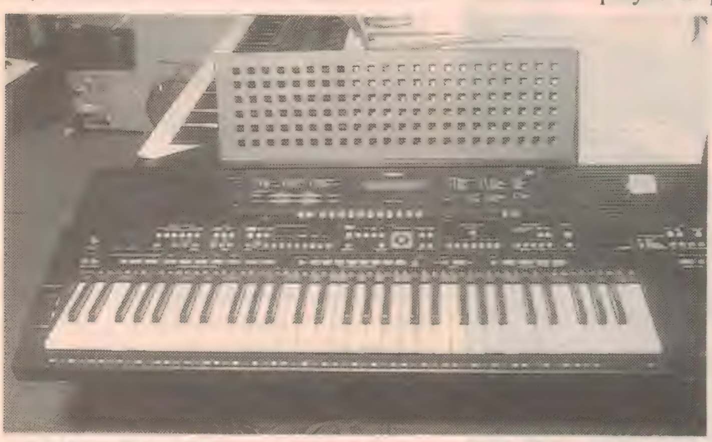
The keys in a modern keyboard/synth are *touch sensitive*, producing a different level of output depending on how hard you hit them. If these levels are then linked to the 32 different levels recorded for the piano or whatever, 'pianissimo' playing of the synth gives nice delicate sounds, while 'forte' playing really makes the instrument get up and howl.

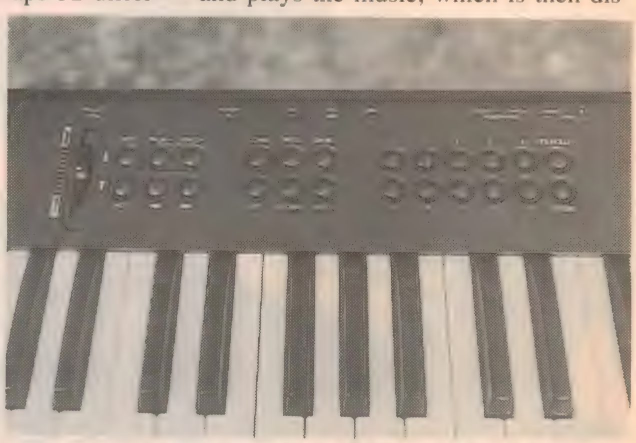
The keyboard/synthesiser has three purposes, then. You can play it on its own in live performance, making it sound like any instrument you desire. Or you can use it as a source of MIDI data, generated by the keyboard, to feed a computer or another MIDI instrument. Or you can feed MIDI data into it, making it play itself hands-free, acting as a MIDI module.

Like modules, keyboards come in price ranges from a few hundred dollars up to many thousands. Well known names are Roland and Yamaha (which represent an enormous range) as well as Korg. There are also some real 'Rolls-Royce' instruments from makers like Kurzweil.

A MIDI keyboard can increase the likelihood of a professional musician making a decent living wage. Take the case of a pub or restaurant that wants to hire a band. Traditionally they would have to employ say four people, one to play each instrument. Each player might play several instruments, and swap them over from time to time, even in the middle of a song. Still, there are four people to be paid, no matter who is playing what instrument.

Another possibility is one performer surrounded by a collection of MIDI instruments, all wired together. This solo muso sits in front of the keyboard and plays the music, which is then dis-





On the left is a Yamaha PSR-1700 keyboard/synthesiser, with a control panel reminiscent of a 747 cockpit, while on the right is the control panel area of a Korg X5 keyboard/synthesiser.

tributed to all the other instruments so they are playing together. It is even possible to transpose one instrument above or below another so the two are playing in harmony, even though the keyboard player is only playing one key at a time.

So one person is doing the work that previously required four. (Isn't that the way, nowadays...?) This one-man-band can then collect the four wages — or more likely, be paid twice the single wage while the pub gets a four-piece band for half price. Which means they'd be a lot more likely to use such a band in the first place.

The latest MIDI keyboards can play several instruments simultaneously — but within the same box, not separately. For instance, the Korg X5 has a 'combination mode' in which up to eight instrument sounds can be played simultaneously from one keyboard. The keyboard can be split electronically so that the lower part plays one set of instruments while the upper part plays another set. The keyboard can be further split so that soft playing generates one set of instruments, while loud playing overlays another set.

It would take a very clever musician to make full use of this, but successful mastery of it would mean he could travel to his gigs with the keyboard under one arm and a guitar-type amp under the other, and turn himself into an eight-piece band. A small computer might also be useful, plugged into the keyboard as an 'electric drummer'.

I have heard fairly simple setups like this, such as one human-played synthesiser driving one or two other synths accompanied by a drum machine. To be honest, they've sounded pretty yucky — like a band made up of synthesisers, because that's what they were.

But with the new sampling technology and synthesisers actually BEING real instruments, a legitimate one-man-band might just be possible. I would suggest that anyone studying to be a professional musician now would be wise to come to grips with this MIDI-and-synthesiser technology, because that's where the jobs are going to be.

The innards

What, then, goes into a MIDI keyboard or module? Some keyboards are more elaborate than others; some let you 'manufacture' your own sounds, while others are pretty well preset. Here we will closely examine the Korg X5, since that's the one I have access to. Others would be much the same.

The Korg begins with six megabytes of ROM, filled with 340 sampled instruments, as well as some drum kits. These are called 'multi-sounds' because each and every one is sampled at 32 different intensity levels, as mentioned above. Korg's multi-sounds include instruments from Accordion to Xylophone and everything in between, such as Bouzouki and Log Drum. These are 'clean' samples, unadorned by any effects at this stage. They are the raw materials for what comes later.

You can select one, or two, multi-sounds to make a 'program', which is the actual instrument you play. Program, in Korg-speak, is called 'instrument' by Roland, 'voice' by Yamaha, and 'single' by Kawai.

Korg has 128 programs preset as the General Midi instruments, and there is space for a further 100 which you can make up yourself. The Korg has a program edit buffer in which you can apply different effects to the multi-sounds — reverb, frequency filtering, attack/delay times, and special goodies like the Leslie rotary speaker effect.

There is a little LCD screen to display what you are doing, and you use push-buttons to navigate your way around and set parameters. There is also an analog slider control, which quickly moves the selected parameter up and down so you can listen to the effect. Once you're happy with everything you can save your new instrument, along with a name, in one of the 100 read/write positions.

In the early days there was no edit buffer, in fact no storage. You selected voices and effects with a series of patch cords plugged into a thing that looked like a telephone switchboard. To this very day, user-generated instruments are still sometimes referred to as a 'patch'.

As mentioned above, you can combine up to eight 'patches' so they can be played simultaneously from the one keyboard. Korg calls the result of this a 'combination'. There is another edit buffer for combinations, and you set them up selecting various instrument ensembles and effects, using similar techniques to the program editor.

Once you have prepared a collection of programs or instruments or whatever, you can assign any of them to one of sixteen MIDI 'channels'. Roland calls this arrangement a 'part'. Incoming MIDI commands, tagged with channel numbers, can then turn on one note on a piano, for instance, another note on a tuba, and then turn off the piano note and then the tuba note. A MIDI device that can do this 'multitasking', or play 16 parts at once, is said to be *multi-timbral*.

With a multi-timbral keyboard playing to beat the band, sixteen parts at once, there has to be a limit somewhere. This is its *polyphony* specification. A good synthesiser/keyboard has 32 or 64 note polyphony, meaning this is how many notes it can play at once. The number is the total for all the MIDI channels — so if you were playing say eight notes on each of four channels, then there would be no notes left for channel five. In 'real world' music, the polyphony limit is seldom reached.

In the second instalment of this series, we will look in detail at computers and how they can be used to take control of a MIDI system. We'll investigate some of those 'word processor for music' programs, and even some software that will 'painlessly' teach you to play the piano.

(*To be continued*) ❖

A Roland XP-50 keyboard/synthesiser, which Roland describes as a music workstation. Note the 3.5" floppy disk drive at the left hand end.

NEW BOOKS

Satellite reference

THE 1995 WORLD SATELLITE ALMANAC, Seventh Edition, edited by Monica L. Kenny. Published by Phillips Business Information Inc, 1995. Soft cover, 280 x 217mm, 550 pages. ISBN 1-881537-28-5. Australian price $299 plus $8 postage.

In satellite communications the developments seem to come at an ever-increasing rate, which must make it very difficult for people working in the field to keep up. However this latest edition of the respected *World Satellite Almanac* makes an even more valiant effort than before to provide a comprehensive, informative and up-to-date reference.

There are nine main sections, dealing respectively with operational geostationary systems; operational non-geostationary systems; planned geostationary systems; planned non-geostationary systems; international and regional networks; transponder brokers and resellers; telecommunications policy organisations; national data, regulation and policy; and finally reference data. In all there's operational, technical and business information on some 70 satellite systems and 90-plus operational satellites, with 500-odd EIRP contours.

Of course the sheer volume of information in such a reference can be a problem in itself. However the editors have thoughtfully provided multiple indices, to make it easier to track things down. As well as a general index there's a systems index, an operators index, a geographic index, a launch schedule, a table of geostationary orbital positions and finally a 'services offered' index, with cross references.

It provides a huge amount of information on the world satellite situation as at 1995, and it should be extremely valuable to anyone working in this field.

The review copy came from Australian distributor Peter C. Lacey Services, of 80 Dandenong Road, Frankston 3199, which can supply it direct for the price quoted. Phone (03) 9783 2388, or fax (03) 9783 5767. (J.R.)

Batteries and stuff

BATTERIES, CHARGERS AND EMERGENCY LIGHTS, by M.C. Sharma. Published by BPB Publications, 1993. Soft cover, 138 x 215mm, 245 pages. RRP $19.95.

Despite their long and interesting history, and the important role batteries play in our lives, there are surprisingly few books about them. This book, from New Delhi publisher BPB Publications, describes most of the commonly used batteries and a range of battery related products like chargers, inverters and battery-powered fluorescent lights.

Although its production quality is not as high as more expensive books, it includes numerous illustrations, circuits and tables. The text has the occasional grammatical error, but in general is easy to understand, concise and friendly — if slightly old-fashioned.

The coverage of batteries is broad and quite detailed and covers most of the common types. Not included, though, are the more recent types of batteries like the nickel metal-hydride (NiMH) battery now used in many laptop computers and portable equipment.

There are chapters on battery eliminators (see what I mean by old-fashioned?), voltage monitors and battery chargers, with even an explanation of how to rejuvenate dry cells. A chapter each is devoted to charging lead-acid cells and NiCads, with a range of charger circuits and a discussion of each.

The book ends with a brief look at troubleshooting and a data appendix. The level suits both beginners and professionals, and the content is surprisingly complete. In the opinion of this reviewer, it's a bargain. The review copy came from Jaycar Electronics, and is available from your nearest Jaycar store, catalog number BM-2484. (P.P.)

TV reception guide

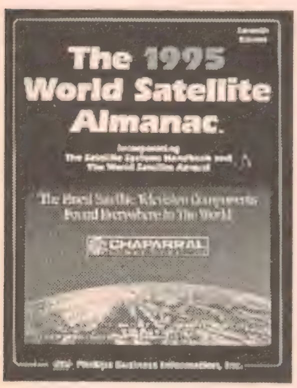
TV ACROSS AUSTRALIA: THE CARAVANNERS GUIDE TO TELEVISION RECEPTION, edited by Robert R. Haverfield and Margaret M. Haverfield. Published by Australian Broadcasting Directories, 1995. Comb binding, 298 x 213mm, 116 pages. ISBN 0-646-25472-3. Price $19.95 plus $3 P&P.

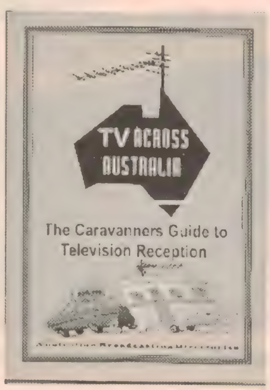
Although this book is nominally intended for those moving around Australia by caravan, as a handy reference for TV reception in each area, by its very nature it also turns out to a valuable and 'user friendly' reference on Australia's 1900-plus TV stations, for almost *anyone*.

Based on information derived from various AGPS publications, including *Radio and Television Broadcasting Stations*, it presents this material in a convenient and accessible form. The country is divided into 30 regions, with a map for each showing all of the station locations, followed by all of the information required for their reception. It's all indexed for ease of use, and there's also some 60 'Handy Hints' to help the reader get the best TV reception.

For more technical readers it does contain the odd howler — like the reference in a number of places to 'Yargi' antennas (poor Mr Yagi!). But on the whole, it does present a lot of very useful information for anyone interested in TV reception in Australia.

The review copy came from ABD, which can supply it direct by mail for the price quoted. The address is PO Box 294, Kippax ACT 2615; phone or fax (06) 254 1934. (J.R.) ❖





MOVIES ENTER THE DIGITAL ERA

Early special effects in the movies were created almost entirely with mirrors and black velvet. The arrival of the optical printer in later years saw the opportunities for on-screen trickery explode. But now, as Barrie Smith explains, the optical printer is fast conceding to digital film manipulation — not just for the obvious special effects in movies like *Jurassic Park*, but for 'invisible mending' in many other productions

by BARRIE SMITH

In mid 1995, two rival Sydney companies decided to get into digital film conversion and manipulation. By October, both were up and running, rapidly earning revenue to justify the heavy investments.

One, Dfilm Pty Ltd, selected the US Kodak Cineon system; the other, Animal Logic, settled on a UK-derived Quantel Domino. Both are similar in operational principles: a roll of 35mm film is loaded in one end, scanned at high resolution and digitised. Then the image data is 'massaged' using a high end computer workstation, with the digital data stream feeding a high resolution film recorder. The objective: film quality in, film quality out.

Being a Kodak device, Cineon is proudly film-orientated; Domino, product of a broadcast video company, tends more towards a television 'look and feel'.

Some would consider the establishment of a competitive pair of high cost systems in the one city an extravagance, doomed to commercial failure. Yet the two will most likely have quite different supporters: Cineon will doubtless attract feature film makers and high-budget commercial producers, while Domino is probably the ideal machine for TV commercial and broadcast purposes.

Dfilm's Cineon workstation is based on a Silicon Graphics Indigo. The software can perform a wide range of digital image manipulation options.

Cineon's approach

Kodak announced in October 1989 its plan to develop a high-res digital film system. Following intensive development in both hardware and software, the first Cinesite digital film centre was opened in Los Angeles in September 1992. London followed in 1993.

A Cinesite is a Kodak owned and operated facility, with the Cineon scanner and film recorder using a gas laser beam to read and write. But a Cineon facility can also be set up by any independent group with the necessary 'knowhow'; most use a CCD array in the scanner and output to a CRT in the recorder. There may well be a quality difference, and of course cost is a factor.

Dfilm's Solitaire film recorder images Cineon output data direct to 35mm camera negative. A 35 seconds per frame exposure achieves a 'mirror image' of the original scan.

Dfilm Pty Ltd have set up their Cineon operation in Crows Nest, Sydney. The company is owned and operated by major Australian film lab Atlab (65%) together with Acme (35%) — a video post production house also known for its world beating kinescope (video to film) service. Atlab is owned by Greater Union.

So what does Cineon do? If you have even the slightest knowledge of the capabilities of graphics software such as Adobe Photoshop, when used on a single graphic or photographic image, you can expect the same and more from Cineon — in a motion picture environment.

At the start of the chain is the Genesis scanner, developed by Kodak. The film recorder is a Management Graphics Solitaire. Both scanner and recorder use an Oxberry pin-registered film movement. Host computer for the scanner is a Sun, while Silicon Graphics supply the work station — the manipulation software is a 'Kodak original' and unique to the platform.

I spent some time with Dfilm's GM Alan Robson and Effects Manager Robert Sandeman, checking out the system.

Hi-res scanner

In capturing the full resolution of a 35mm frame (four perforations, 18.7 x 24.9mm image) the maximum scan covers 4096 lines horizontally by 3112 vertically — a '4K' scan. Other formats can be scanned — right up to an eight-perforation VistaVision (25.2 x 37.7mm image).

But most demand here and overseas

Movies Enter The Digital Era

The Genesis film scanner used in Dfilm's Cineon system handles both 2K (2048 x 1056 pixel) and 4K (4096 x 3112 pixel) scans per 35mm film frame.

is at the '2K' level, with 2048 x 1056 image resolution.

Alan Robson indicates that "to the person sitting in the cinema and the film makers, that is quite acceptable — so there's no discernible change when the scene is put back into the film. It is also cheaper than doing it at full film resolution."

One film in recent times that did use a '4K' transfer was *Waterworld*, believed to be the first movie ever to use full digital film resolution throughout. In '2K' image scanning, 10MB of data per frame is produced; at '4K', 40MB/frame is reached, and VistaVision gets to 100MB/frame.

The scanner feeds to a Sun host computer. Scan time for a 2K frame is 15 seconds, writing directly to disk or other peripherals. A 4K scan takes 30-35 seconds.

The scanner comprises a horizontal film transport, made by Oxberry. The CCD's 4096 elements are in a single line array, three elements deep; the scan is made in a single pass.

The CCD (above) and imaging lens remain stationary, as does a narrow integrator glass; the film frame (beneath), held in registration by a pin, moves laterally across the CCD. The advantage is that the optical information passes through the optical centre of the lens (a Schneider).

The setup would appear to share components with Kodak's Photo CD scanner, but I was informed the processing electronics are quite different. Image capture is at a 10-bit depth per colour.

A monitor is used to set up a scan. Lookup tables for every Kodak film emulsion are consulted and the specific one selected to tailor individual characteristics such as granularity, contrast and colour saturation.

Robert Sandeman explains it is "very easy to operate". The scan data is passed to a Metrum 1/2-inch tape streaming peripheral and also makes a background pass via fibre optic cable directly to the main work station — in real time. The streaming tape can hold 18GB of data, or 1500-1800 2K frames of data. An EDL (Edit Decision List) accompanies the transfer, so each frame's address is retained.

Image manipulation

Finally, in a separate suite, the data reaches the Cineon database, which is configured and based on a Silicon Graphics Indigo II system, with 64GB of storage and 384MB of RAM.

Says Robson: "Depending on the amount of work that comes in, we may go for an Onyx or a number of Indigos in multi processing mode. But we're finding and hearing that the single processor platform certainly is much more efficient than maybe going to the eight processor Onyx."

The Cineon software is specifically written for the SGI platform, which

Left: A Cineon CCD based scanner. The light source is at bottom, with the CCD image sensor at top. Right: Cineon's scanning setup screen allows fine tailoring of the scan to suit specific film emulsions.

handles the image manipulation stage.

Robson adds: "We've taken Cineon because it's very film oriented and film specific in the task. It's very good at degraining and regraining, because obviously it understands the qualities and properties of film stocks.

That's why restorations like *Snow White* and similar have been done on the Cineon. It's very good at those film things, which are colour management, compositing, rendering and grain management — basically the system can do anything in the manipulation of film.

"What it doesn't do is things like 3D and animation. That's why we're interfacing with companies who specialise in those."

Film recorder

The pin-registered film recorder is a Solitaire FLX Cine3, which uses a slit-scan process to reduce flare from the CRT. Towards the same end an optical block has also been placed in the light path immediately above the film to be exposed; dust and dirt is also excluded.

Sandeman explains that "The record write time is about 35 seconds per frame, in either 2K or 4K. At this speed we achieve a mirror image of what was achieved in scanning."

The camera negative is usually Type 5245, a slow, low contrast, fine grain stock commonly used by camera men for normal high quality shooting. The Cineon film output can be spliced directly into the production negative.

The Cineon system is capable of other configurations: Alan Robson foresees that Kodak may soon develop a 16mm system, especially in view of the high acceptance of the wide screen compatible Super 16 gauge.

The input can be negative or print or internegative, black and white, Agfa, Kodak or Fuji film. Whatever stock is input the system will compensate and correlate.

A Cineon negative could be used to blow up to 65mm print release if transferred at the 4K level. There may well be some local projects in this format in the near future.

Big potential

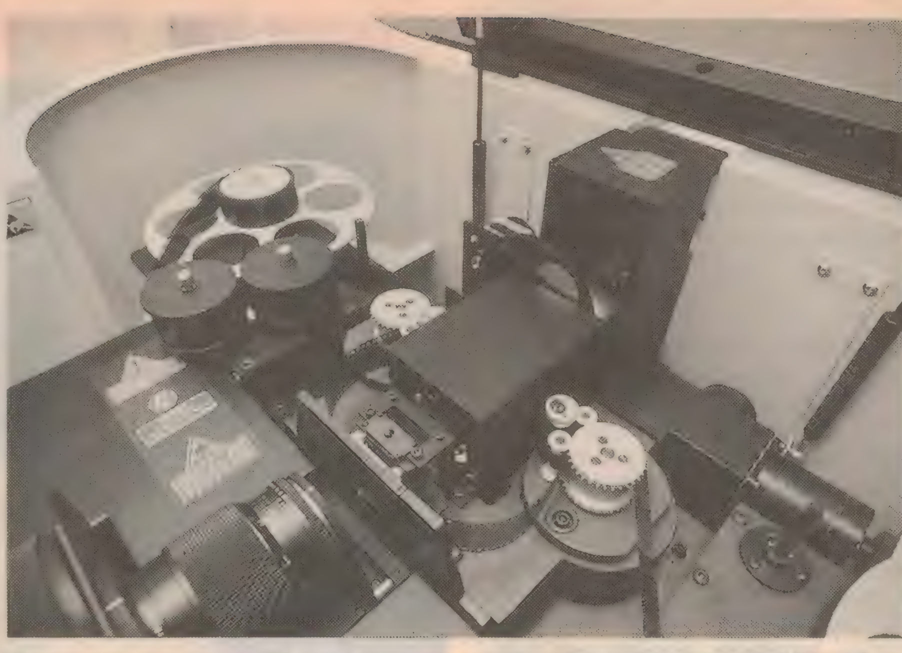
Alan Robson admitted he is "very much encouraged by the instant acceptance of Cineon. After operating only a month, we've already done one job for a Chinese production, called *Sun Valley*; now we're working on Richard Franklin's production out of Melbourne. The *Sun Valley* people are so pleased with what we've done for them and they have now given us more work."

A likely use for Cineon could also be salvage work on damaged negatives — thereby saving insurance companies large sums. It is likely the Canberra film archive could be a customer, in their guardianship of millions of feet of our cinematic history. Other possibilities could be authoring for CD-ROMs, Web pages for the Internet, etc.

But Cineon does not mean the end of opticals. Dfilm still operates two double head Oxberry machines, which are kept busy adding simple effects to feature films that don't require the 'high wire act' offered by Cineon. Alan Robson says "the optical path is still a very efficient and preferable one, because it is still often more time and cost effective than digital".

Cineon's tricks

A million bucks worth of Cineon, a trained operator and a hundred thousand feet of negative film — and you're away with digital film manipulation. So



The Domino scanner. The light source is at top right, with the CCD sensor at bottom left. As with Cineon the film frame moves during scanning.

The Domino scan monitor and D1 recorder.

what has been it been up to?

A segment of a 1953 Ingmar Bergman film was restored in Cineon. The red and blue dyes had virtually disappeared, leaving the screen image a vision in green. Inspection of the colour histogram revealed that the missing colour information was still present in the emulsion — but much reduced. Image processing raised the red and blue records level with the green. Voila! Full colour had been returned.

The Cineon software can perform other magic: the image can be sharpened, softened, flipped, flopped, areas filled with colour, zoomed up, repositioned, 'dustbusted', 'descratched' and 'despeckled'. Artefacts such as scratches and hairs that move within the frame can be detected, tracked and filled. Colour saturation, gamma and luminance can be altered. Grain can be diminished or increased: a low grain emulsion can be given the characteristics of a grainy one, and vice versa; this is useful when a DOP (Director of Photography) has used a mix of stocks in his shooting.

The 1937 Technicolor three-strip *Snow White* movie was obviously a resource that could bolster the Disney Organisation coffers. But time had taken its toll on the original colour saturation and colour alignment, as well as flare and dust becoming evident — Cineon to the rescue. And, after a 10-week stretch of 40 people at times working three shifts, it processed a total of 15 Terabytes of data derived from the original 119,550 frames of scanned film.

Since then, *Fantasia* and *Pinnochio* have undergone the process. More recently, *My Fair Lady* has also enjoyed Cineon's restorative attentions.

Free Willy 2 required work on the grain structure of the whale stock footage, while *French Kiss* required a sunset train interior to match the exterior background footage.

Naturally, the heaviest, most successful camouflage is invisible and unpublicised by the producers. Some other films that have undergone 'the knife' have been *Speed*, *Judge Dredd*, and *Quiz Show*.

Much useful work is done when a period film location is perfect in every way — except for overhead power lines. Such removal is a relatively simple chore. Movies that call for the actor to be suspended often call for wire removal. Expect to see Hong Kong producers trekking to Sydney with their high flying Kung Fu spectaculars!

Chris Godfrey at the Domino workstation. Quantel hardware is a closed architecture, however, the Domino system's output is industry standard D1 digital video.

When *Star Wars* was made in 1977, a single frame of special effect cost US$18,000; by the time *Jurassic Park* was in production this had fallen to US$2000 per frame. Sydney's Cineon recently completed a simple effect for a client that cost A$3000 — for the whole scene.

Domino approach

Sydney digital house Animal Logic's R&D man, Chris Godfrey said he "had to take a deep breath" when signing the cheque for $2 million, the purchase price of their Domino system.

The company has a significant presence in digital manipulation of the video image — both here and overseas. It also has a major inventory of Quantel 'Henry' and 'Harry' devices. This pile of hardware is supported by significant activity in creating purpose written software.

With a high deployment of Quantel systems, it was natural that Animal Logic should take on Domino.

Says Godfrey: "We looked at all the other systems, spent a lot of time looking, and this was the most rounded system that suited us."

Domino has obvious similarities to Cineon in its scanner and recorder. Both scanners use an Oxberry film movement, although the Domino's is set up horizontally; both use the Solitaire FLX Cine3 recorder.

In Godfrey's opinion Domino's quality cannot be surpassed unless one goes to a Cinesite, where the laser in/output are totally matched to film characteristics. The Domino scanner makes a 2880 x 2048 pixel scan (or at an alternative 1440 x 1024 level) at 12 bits colour depth. This is achieved at 15 seconds per frame. The scan data is transferred to an industry standard D1 digital recorder. At the output end transfer is at 45 seconds a frame to Type 5245 camera negative.

The Domino workstation can achieve most of the effects performed by Cineon, but possibly has less of the specifically 'film touchup' modes of the latter.

Godfrey's company is not a bureau and will offer Domino as part of its total service. He can see most of its time being spent on commercials. ❖

Cineon vs Domino

Dfilm's Robson compares the two systems: "From a film perspective, the Cineon has an advantage because of the 10-bit algorithm in colour sampling. Also we do true full film resolution at 4096 lines — Domino does 2880. Cineon is also an open system, so we can interface with other industry players to give local and other film makers an option."

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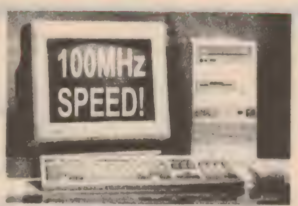

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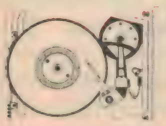

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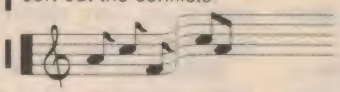

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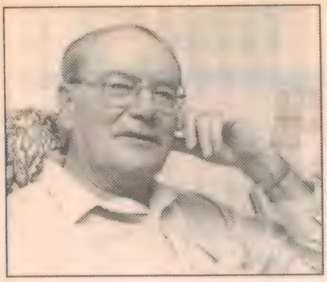


When I Think Back...

by Neville Williams

Vincent Stanley: A family involvement in AWA, during its vital formative years

Prompted by the 'When I Think Back' series in *EA* and by stories reprinted in *Australia's Radio Pioneers*, Gerald ('Gerry') Stanley and his sister Phyl Alston (nee Stanley) decided that their late father Vincent Stanley should also qualify for a mention, because of his role at AWA's pioneering wireless centre at Pennant Hills, NSW — as a contemporary of George Cookson and Sydney Newman.

Personally, I had no difficulty in 'Thinking Back' afresh to the period in which the Cookson and Newman stories were set. The site, what's more, is a mere kilometre away for my home, although occupied these days by a couple of schools and a community centre.

And yes, with the benefit of hindsight, Vincent Stanley most definitely qualifies for inclusion in the Pennant Hills story. It remains for me to reset the stage and add another player. (With acknowledgment to W. Shakespeare.)

Back in the early 1930s, when my parents moved from 'the bush' to the suburbs of Sydney, my father continued his habit of taking the family for 'a run' in the car on Sunday afternoons. As often as not he would head for the 'hills' district, to seek out fresh farm produce. En route we would pass a big fenced paddock dotted with an assortment of buildings and towers, comprising what was then referred to as the Pennant Hills wireless station.

Who did exactly what there was not apparent — beyond the knowledge that it had been set up by the Federal Government, years before, to provide wireless/radio communication with other countries and with ships at sea, mainly in Australian waters.

Much, much later, I got to write a story about the complex (*EA* September '91), which included an historic aerial photograph of the Pennant Hills countryside as it would have been in my teenage years. Chosen as the site for Australia's newest and most powerful wireless centre, it offered the necessary accessible space at the time — far enough from the coast not to present a too-easy target for a prowling enemy warship!

The late Vincent ('Vin') Edward Stanley, as the Engineer-in-Charge of the Pennant Hills Wireless Station. A contemporary of George Cookson and Sydney Newman, he had an active role in promoting AWA's expansion into wireless communication and public broadcasting.

Authorised in 1910, the station had been opened in 1912 using equipment variously supplied by Telefunken and Father Shaw's Australian Wireless Company, based in Randwick, NSW.

In 1922, the Federal Government purchased a controlling interest in AWA, a rival company under under E.T. Fisk, and delegated to it responsibility for maintaining and operating the Australian Coastal Radio system. Included were the existing facilities at Pennant Hills.

Cookson and Newman

Under the new arrangement, a technician — George Cookson — was among those posted to the Pennant Hills Centre. A young Queenslander, he had studied wireless by correspondence through ICS while earning a living as a bread carter. He had also gained practical experience during the war as a coastal radio operator in Cooktown, attached to the Royal Australian Navy.

At about the same time, facilities at Pennant Hills were extended by adding short-wave equipment, including a telephony transmitter (2ME) which gave Australia a human voice on the international air waves.

Cookson was later sent overseas to study trends and equipment. On his return, he was appointed as engineer-in-charge of the Pennant Hills complex, with the Cookson family living on site.

Later, with the commencement of public broadcasting, George Cookson was assigned to the installation of several radio stations in Australia and New Zealand, and rounded off his career by supervising installation of the then-huge HF receiving centre at Doonside in NSW.

Born in 1898, some 11 years after Cookson, Syd Newman (see *EA* January

'91) did not get caught up to the same extent in primitive arcs and sparks, low transmission frequencies and tedious telegraphy. A resident of Melbourne, he was influenced rather by the amateur radio movement in that city, and passed through the amateur ranks on his way to becoming a professional engineer for AWA.

As such, his technical background fitted the Fisk concept of shortwave propagation, valve technology, 'Beam' Wireless and increased reliance on telephony. He did much to update the thinking and equipment in the coastal service and, amongst other things, personally supervised the design and installation of the aforementioned 2ME transmitter at Pennant Hills.

At home in one of the staff cottages Vin Stanley, his wife Annie (left) and daughter Phyllis — who later held a secretarial position in the AWA office in York Street. Behind the group is the family 'Radiola'

Vincent Stanley

Now we come to Vincent ('Vin') Edward Stanley, who was born at Balnarring on the Mornington Peninsula in 1896, making him both a fellow Victorian and a close contemporary of Syd Newman. As a teenager, raised on a small sheep property, he would frequently ride his bike — later motorbike — from the family home to the naval base at Hastings, where he had his first encounter with the practicalities of wireless.

A handyman/hobbyist by nature, rather than an academic, he set to and built his own crystal set — the first step in countless wireless careers, around the 1920s.

With the outbreak of war Vin Stanley joined the AIF, only to succumb to rheumatic fever while still in the Broadmeadow Camp and be discharged as medically unfit. Towards the end of WW1, however, he enrolled with the Marconi School of Wireless and, on gaining his certificate joined the Commonwealth Shipping Line as a radio operator on its 'Austral' cargo ships.

Married in 1923, he abandoned his sea-going job for a position as a technician on the staff of the new broadcast radio station 2FC, established by the Farmers store in Park Street, Sydney. This opened the way to a position as second-in-charge to George Cookson at the AWA centre at Pennant Hills, thereby freeing George for assignments on behalf of AWA's Commercial Engineering section.

The original 'Telefunken' building, which still carried the badge on an inner wall, long after it had been pensioned off. Vin Stanley set up his office in the front left corner, the remainder of the building servicing as a storeroom. The main central antenna mast remained in use.

In the early 1930s Vin Stanley was himself promoted to Officer-in-charge at Pennant Hills and, in turn, was also given special assignments for AWA, such as setting up new radio stations at Goulbourn (2GN) and Katoomba (2KA).

He also had dealings with Charles Ulm and 'Scotty' Allen, who visited Pennant Hills to inspect and discuss what could be the base station for their communications link. He also made several test flights with them, to check on the airborne end of any such link.

In 1938, Vin Stanley turned accumulated leave to good purpose by signing on as radio operator for the *M.V. Merkur* for a round trip to Singapore. It gave him the opportunity to refresh his experience afloat and to visit shore installations in Java, at that time under Dutch control. After that it was back to Pennant Hills...

The Stanley kids

Looking back over the days that they lived on site as 'the Boss's Kids', Gerald and Phyllis Stanley recall that the Pennant Hills centre occupied a paddock of some 400 acres. Large enough to have its own creek, it was located at the intersection of Pennant Hills Road and North Rocks Road. Nearby properties were occupied by peach orchards and poultry farms.

The Engine Room, intended to keep the station on air in the event of a mains failure. Gerry Stanley says that the much patched leather driving belt indicated plenty of work in other days, but he could not remember it ever having been run while he lived in the station.

The site was also large enough to present its own fire hazard, from a thick covering of dry grass. Not only did it pose a risk for neighbouring properties, but many of the smaller masts and feeder supports were of wood.

In his day, and with his rural background, Vin was very conscious about this — but was denied the easy option of grazing cattle on the property because the feeder cables were at just the right height for cattle to blunder into them. So Vin suggested running sheep instead, but officialdom withheld permission on the grounds that Pennant Hills was not considered appropriate sheep country!

(Gerald added that, while Vin lost that particular battle, he did not lose the war. When a new receiving station was erected at Doonside, he argued successfully that all feeder cables and structures should be cattle proof!)

Three brick cottages had been erected along the Pennant Hills frontage to house the on-site staff and their families, with a shared tennis court behind. These, too, held long-time memories for Gerald and Phyllis.

That the houses were subject to strong RF fields was evident from the fact that the neon pilot lamp in the Stanley kitchen power point lit up when a certain antenna was in use — even with the associated power switch turned 'off'.

More curious was the situation when a nearby antenna was being used to transmit a regular program for the armed forces. Standing under the shower, one could hear the transmission quite clearly — but not demodulated because of any identifiable electrical effect. The Stanley bathroom was fitted with a wood burning chip heater!

One other memorable occasion was when 'Dad' — Vin — bought a second-hand refrigerator. It was 'non-operational' but although he knew nothing about refrigerators, he was still confident that he could fix it.

Unfortunately, regular refrigerant gases were virtually unobtainable during wartime but, having learned how the thing functioned, Vin set about converting it, as Gerald remembers, from ammonia to sulphur dioxide! Right or wrong, "it did work, and we were one of a very few families in the area with a refrigerator".

Station equipment

In the centre of the block was a large, guyed, lattice steel mast 300 feet (91 metres) tall, with two smaller masts to support the main antenna diagonally across the block (NE to SW). Various other small masts and antennas were scattered around the property, some of them presumably left-overs from earlier experiments.

The main mast was fronted by what was probably the oldest building on the site. Its role had been to house the original Telefunken transmitter, and Gerald recalls that, while a much larger equipment centre had since been erected, the old building was still referred to as the 'Telefunken' house when the Stanley family lived on the site. One section had been taken over as his father's office, with the rest of the space doubling as a store.

About 50ft (15m) away was another relic of the past — the engine room, plus a workshop. As he recalls, the engine room contained a four-cylinder Gardiner kerosene (?) engine, driving a generator via a (very) wide leather driving belt.

To the best of his knowledge, the system had never been used during their term of residence; but it had the appearance of being capable of responding in an emergency. Certainly, from the number of repairs to the belt, it had seen plenty of service in other days.

The associated workshop facilities were fairly routine — drills, lathes, equipment for sheet metalwork, welding and hand tools.

The new transmitter room, according to Gerald, was a long rectangular build-

More spacious and better ventilated than the old Telefunken cottage, the 'new' transmitter building accommodated the transmitters around the walls, with control and switching facilities in a centre aisle. At this stage, the facilities were manned 24 hours per day.

ing with lots of windows, obviously intended to dissipate heat from the equipment. Entry was via a large roller door, often left open for the same reason.

Transmitters were arranged along the four walls of the main floor. To the youthful Gerry, they were "massive grey structures of sheet steel and angle iron, housing enormous valves that lit up like giant light globes. Their anodes would glow dull red, changing in intensity with the modulation."

"Large chrome-plated hand wheels adjusted the transmitter operation, controlling large edge-wound tuning coils (as he remembers) about 10" — 25cm — in diameter and comprising about eight turns of copper strip."

Looking out over the Wireless Station from the back door of the Stanley cottage, roughly as it would have appeared to motorists on Pennant Hills Road. For the Chief Engineer, troubleshooting on dark, wet nights would have been an uninviting prospect.

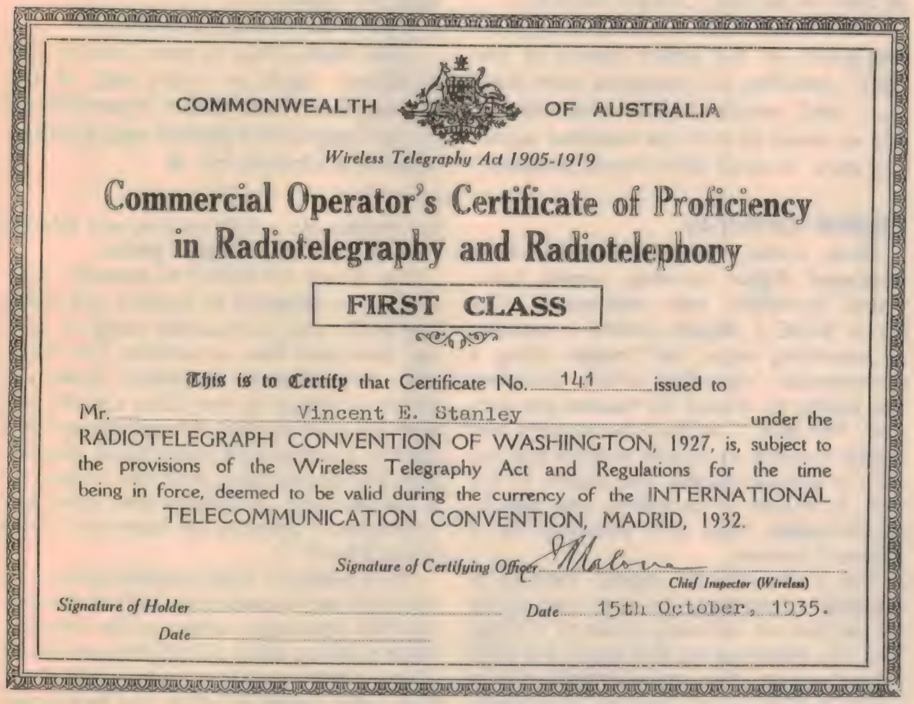
Additional equipment

"In the centre of the room was the control equipment — more grey panels covered with knobs, switches and meters — the latter dancing with the modulation."

"In a sort of basement under one end of the transmitter hall was a collection of motor-generator sets suggesting, as I recall, that the system had been fitted out to operate from an emergency supply drawn from Railway Department's DC system."

"The station appeared to be operational for 24 hours per day, in contact with equivalent stations from around the world on telephony or Morse Code. A common subject for discussion was the relative effectiveness of radio contact, compared with cable links."

"At the other extreme, one of the transmitters in the system operated a service for the local Hornsby Shire Council, under the call sign KKK7, providing one of the first ever mobile radio services. A staff of two operated the system for each of three eight-hour shifts, plus the outside staff needed to respond to emergency situations."



COMMONWEALTH OF AUSTRALIA

Wireless Telegraphy Act 1905-1919

Commercial Operator's Certificate of Proficiency in Radiotelegraphy and Radiotelephony

FIRST CLASS

This is to Certify that Certificate No. 141 issued to Mr. Vincent E. Stanley under the RADIOTELEGRAPH CONVENTION OF WASHINGTON, 1927, is, subject to the provisions of the Wireless Telegraphy Act and Regulations for the time being in force, deemed to be valid during the currency of the INTERNATIONAL TELECOMMUNICATION CONVENTION, MADRID, 1932.

Signature of Certifying Officer [signature]
Chief Inspector (Wireless)

Signature of Holder .... *Date* 15th October, 1935.

Date ....

The original 'ticket' issued to Vin Stanley after a course with the Marconi School. After about six years as a shipboard operator and practical experience ashore, he became Officer in Charge of the Pennant Hills (NSW) Wireless Station.

In the 1930s AWA operated a separate listening centre at La Perouse, with multiple landlines linking it to Pennant Hills. Among his father's effects is a photograph of a social tennis day between the respective staff members, held at the Pennant Hills court.

During this period AWA also managed the technical facilities for Sydney's religious broadcasting stations 2CH and 2SM. The catholic station (2SM, Saint Mary's) operated from a site just across Pennant Hill Road from the transmitting centre. Its protestant counterpart (2CH, Council of Churches) had been set up on property owned by Sir Frederick Stewart at Dundas, close by the present Lottie Stewart hospital.

As an economy measure, AWA arranged for both stations to share a common mast adjacent to the Pennant Hills complex — much to the amusement/annoyance of the rival listener groups. How could the electrons dance simultaneously to the catholic and protestant tunes?

Nowadays the stations have gone their own separate ways, with different shareholding and management. The common mast has disappeared, along with the original AWA communications complex.

The humour of the situation would not have been lost on Vin, who according to his son had a strong sense of humour and a partiality to harmless practical jokes.

On one occasion, a member of the staff discovered and killed a snake on the property. Vin's method of disposing of the carcase was to coil it carefully around the toilet seat, as a greeting to the next visitor.

WHEN I THINK BACK

mantling and repairing a clock. His contribution to the process was to surreptitiously drop an extra cogwheel in the pile of 'bits'!

Then there was the time when he noticed a couple of technicians building up a piece of transmitting equipment in the workshop. To his practiced eye it was immediately apparent that it would not fit through the doorway. When the men later confessed their error and embarrassment, Vin said he had known about it all along, but had checked to ensure that the unit could be hoisted out over the partition!

Vic's pet aversion was pompous officials. On one occasion, just after the launching of the Russian Sputnik, a technician had measured and announced its orbital speed using the 'Doppler shift' effect on its transmitted frequency.

To some minor official the announcement sounded like an indiscretion, such that use of the term should perhaps be banned. Vic assured him in no uncertain terms that "even schoolchildren these days know about Doppler effect". When Gerald walked in that afternoon, "Dad bellowed at me: 'What's Doppler effect?' He was just trying to make sure!"

Vin Stanley retired in 1961 to a house quite close to Pennant Hills railway station, where he continued in his hobby of photography and history. He died in 1966.

FOOTNOTE: Phyllis Alston (nee Stanley) obtained a position in the Commercial Engineering Department of AWA, which administered AWA Beam Wireless and Broadcasting facilities. At the first opportunity we will publish her own story, of life in the AWA tower building from a woman's point of view.

Studios revisited — just in time

Just as I was about to send this column to the Editor, the following letter arrived:

Dear Neville,

As a postscript to 'When I Think Back' in the December EA, I thought you might be interested to know that Dave Tapp, John Warren and I did manage to make a last nostalgic visit to the underground ABC studios, which you so accurately covered in your recent article.

I located the article in the SMH of August 28, 1995 (which incidentally I had not seen), and read that the ABC building was due for demolition in September. So realising that time was running out, I rang Harry Seidler's office and, thanks to the good graces of Gil Williams, I contacted demolition foreman Dave Waterhouse, who was on the site.

The demolition was already in progress. This, by the way was Friday, December 15. I explained our interest to him and he was most cooperative — arranging for the three of us to meet him at 2pm on Saturday, which we did.

The demolishers were already eating away at the upper floors of the 'new' building so, equipped with hard hats and torches, Dave Waterhouse led us down to our old wartime working area. A week later would probably have been too late.

It was fantastic to walk through the old rooms and studios after some 40-odd years. I still have a clear mental picture of how it was in the 1940s and 50s, and it is sad to see the mess that was left.

Apparently since the ABC moved out it had become a refuge for derelicts and drug addicts, to judge by the junk and needles lying around. The big pity is that no one at the time saw fit to photograph the place, as far as I know, so an important part of broadcasting history is being lost forever.

One thing that I did discover was that my memory of the layout of the bunker, while not exact, was basically correct. The demolition foreman said that the site will be levelled by February, ready for the new 43-story building.

He was interested to hear about the dimensions of the bunker roof, and had been wondering as to whether it would pose a problem to remove — even though they have some impressive machines on the job. I will drive over that way in a few weeks time to have another look, by way of interest.

Thank you for your interest in committing the story to print. At least there is now some record of this bit of history. I rang Geoff Harris the ABC Archivist and told him of your article, and he was intending to get hold of a copy of EA to read it.

My best wishes for a happy Christmas and New Year.

George Paterson (VK2AHJ)

And thanks also to you, George. It's initiatives such as yours and of the Stanley family that makes it possible for *EA* to compile and publish social history relative to electronics. ❖

The Challis Report

Continued from page 13

Addressed Liquid Crystal (PALC) technology, which was developed jointly with Tektronix. The Plasmatron displays are unrivalled for their brightness, contrast picture clarity and quality.

Sony plans initial introduction of the Plasmatron display in Japan in 1996, and in the USA and other countries in 1997. The principle by which the Plasmatron works is based on applying voltage across a partially evacuated tube in which the gas discharge plasma becomes the rear contact for each pixel of an LCD array.

The major benefit of the Plasmatron system is the ability to produce wall hanging TV screens with sizes ranging from 50cm to 125cm. As there was no mention of prospective selling price in either Japan or the USA, it would appear that the Plasmatron will be relatively expensive.

Digital cameras

Ricoh, Casio, Sharp and Chinon each displayed digital cameras, whose functional flexibility was impressive. The Ricoh RTDC-1 digital camera is capable of recording super fast images using a compression algorithm which provides the ability to record 30 frames per second. The RDC-1 is thus the world's first digital camera to record motion scenes, with or without sound. The quality of the RDC-1 images is excellent, and significantly better than that provided by a Polaroid camera.

The Casio QV-10 digital camera is equally convenient to use, can store its picture on memory cards or a chip, thereby eliminating the need for film replacement. The stored digital picture can be fed into your computer, or to a personal video printer to provide an almost instantaneous print. The picture resolution in small scale photos is superb, but in enlarged views (i.e., a portion of a photo) the images are a little coarse, and inferior to a conventional Polaroid photo.

The Sharp VR-MS1U Multimedia view camera is designed to receive still video and audio data without the need for special dedicated lines or cabling. The Viewcam then provides a picture resolution which is similar to the Casio QV-10, but with the primary aim of transmitting video data in a convenient commercial manner, with higher resolution than that offered by a fax machine. It appears that some law enforcement agencies are interested in the Sharp VR-MS1U.

The Chinon ES-1000 Pocket Digital camera is the most compact and affordable digital high resolution camera to be released. With a selling price of US$499 and 24-bit colour photos, it has already targeted the Law Enforcement Agencies and Real Estate Agents in the USA.

With so much exciting equipment at this year's CES, I've run out of space. So I'll continue this review in next month's *EA*.❖

SHORTWAVE LISTENING

with **Arthur Cushen, MBE**

Radio Australia faces major transmission cut

A reduction in the budget to Radio Australia with a possibility of closure of one of the key relay bases at Carnarvon, Western Australia seems eminent, following the Australian Government decision to change the funding for the 'Australia Television' service to Asia.

These days Radio Australia is a major voice into the Pacific and Asia, but is facing a reduction in services. According to a Media Network report, its Carnarvon facility is in danger of being closed due to funding cuts.

It seems that $18.6M is to be poured into the ABC Satellite Australia Television service across South East Asia. $12.6 million will come from direct Government funding but $6M, over three years, will come from funding for Radio Australia. This means that services to the Indian sub-continent would be seriously affected. There would be no backup to South East Asia and there would also be no transmission into East Indonesia — both of which are better served from Carnarvon than Darwin.

Radio Australia has recently moved to a new home, and using the talents and resources of its own broadcasters and technicians the ABC has created one of the world's first fully digital broadcasting facilities. ABC Southbank Centre houses ABC Radio, Radio Australia and ABC Concerts. Radio Australia beams its programmes from this new site to tens of millions of listeners around the world through its transmitter sites at Shepparton, Carnarvon, Darwin and Brandon.

Radio Australia is the ABC's international radio service and broadcasts worldwide 24 hours a day. Targeting Asia and the Pacific, it reaches millions of people in nine languages: English, French, Cambodian, Cantonese, Mandarin, Indonesian, Thai, Tok Pisin (Papua New Guinea) and Vietnamese. In addition to global news and current affairs coverage, its comprehensive programming encourages an understanding of Australian life and of Australia's interest in Asia and the Pacific.

RA began as a shortwave war time service during the Second World War, and remains reliant on shortwave. Today its programmes are also carried by stations in Europe and America as well as Asia and the Pacific. It also broadcasts an English language teaching series to China, Vietnam, Indonesia and Cambodia.

From the Southbank studio complex, RA also provides a service of television news updates in five regional languages; Mandarin, Cantonese, Thai, Indonesia, and Vietnamese, to the ABC's Asian satellite service, Australian Television.

Looking back at the history of Radio Australia, it was established by the Australian Government as a wartime measure to present the Allied case as seen in Australia, to the peoples of Asia and the Far East, to bring home news to Australian forces overseas and to counter enemy broadcasts. Originally known as Australia Calling, the overseas service of the Australian Broadcasting Corporation was inaugurated by Prime Minister Sir Robert Menzies in December 1939. Initially it was operated by the Department of the Interior and the languages used were English, French, German, Spanish, Italian and Dutch. Since the end of the war, however, the last four have been replaced by Indonesian languages.

As well as broadcasting world wide with a midnight to dawn relay of its service on the Domestic Network of ABC, RA also provides a Sporting Service which carries a variety of sports at the weekend.

Ireland extends broadcast

As reported in the September issue, Irish Overseas Broadcasting was reported having test transmissions using BBC transmitters for a relay of major sporting events. So successful were these broadcasts that the group — which are volunteers — were overloaded with reports. Accordingly, the Government operated Radio Television Eireann, Dublin decided there was an audience for shortwave broadcasting and have leased time on WWCR in Nashville, Tennessee.

The official release started that RTE's 'News at Six-Thirty' is now broadcast all over the world from WWCR, in two services. The programme is taken off the Galaxy5 satellite for North American reception, and is rebroadcast twice daily on WWCR. The aim is to provide a daily information service to people who cannot receive the satellite transmission. If reaction is positive from remote areas of the world, they will consider increasing the volume of output.

The service to the Pacific is at 1000 - 1030UTC, Monday - Friday on 5065kHz and on Saturday and Sunday the broadcast is at 1100 - 1130UTC on the same frequency. The service to Europe and North America is at 1930 - 2000, Monday to Friday, on 12,160kHz and on Saturday at 2000 -2030 and Sunday 2100 - 2130 also on 12,160kHz.

Reports should be sent to RTE, Overseas Service, Donnybrook, Dublin 4, Ireland. ❖

AROUND THE WORLD

AUSTRALIA: VJJ, Charleville, Queensland's School of the Air station is located 300 miles inland from Brisbane and is heard on 7792kHz at 2300UTC. Verification came from the News Editor, and the station provides an educational service for children in the outback. The station also uses 4045, 5227, 6495 and 7792kHz, which is a new channel.

ECUADOR: HCJB, Quito has made a frequency change to Europe at 0530 - 0630 with 5955 replacing 5900kHz; at 2000 - 2230UTC it changes from 12,005 to 12,025kHz.

GREECE: Voice of Greece, Athens broadcasts to Australia at 0600 - 0800 on 9425 and 11,64kHz in Greek with the last 15 minutes in English, while a further transmission in Greek only is heard 0900 - 0950 on 15,630 and 15,650kHz. The station is also heard at 2100 - 2250 on 9425kHz with Greek and English at 2240.

HUNGARY: Radio Budapest has English broadcasts to Europe at 2000 - 2030 on 3975, 5970, 7250 and 9835kHz; at 2200 - 2230 on 3975, 5935, 7250 and 9835kHz; to North America at 0200 - 0230 on 6190, 9850 and 11,870kHz; 0330 - 0400 on 5965, 9850 and 11,870kHz.

INDIA: All India Radio, Delhi has English transmissions to Australia and New Zealand at 1000 - 1100 on 13,700, 15,050 and 17,387kHz; and at 2045 - 2230 on 9910, 11,715 and 15,225kHz.

IRAN: Tehran is heard on 9022kHz with French up to 1830 - 1930 then English 1930 - 2030UTC. The station has come sideband interference from Sudan, now on 9026kHz having moved from 9020kHz. The station has also been noted in English at 1230 on 11,875 and 15,260kHz.

ITALY: Italian Radio Relay Service, Milan operates using 10kW daily at 0600 - 0830UTC on 3985kHz; 0830 - 1530 on 7125kHz; 1530 - 2100 on 3985kHz; and Friday, Saturday and Sunday on 2100 - 2300 on 3985kHz.

All transmissions are into an omni-directional antenna. Good signals have been heard around 1900 on the new 3985kHz channel.

NEW ZEALAND: RNZI, Wellington has made a frequency change and is now 1650 - 1750 on 5960kHz Monday to Friday and daily 1750 - 1950 on 9810kHz. The balance of the schedule is unchanged.

PAKISTAN: Radio Pakistan, Islamabad is heard with English news at 1100 - 1105 then slow speed news to 1125UTC on 15,470 and 17,895kHz. According to a verification there is English to Europe at 1700 - 1900 on 7295kHz and 11,570kHz.

PHILIPPINES; FEBC, Manilla has English broadcasts at 0000 - 0200 on 15,450; at 0930 - 1100 on 11,635kHz; 1300 - 1600 on 11,995kHz. Radio Philipas also broadcasts in English 0230 - 0330 on 17,760kHz, 17,840 and 2158kHz.

PAPUA NEW GUINEA: Port Morseby has had transmitter problems but is now operating with 100kW at 2000 - 0800 on 9675kHz, and also 0800 - 1400 on 4890kHz, according to the technician phoned at the station.

VANUATU: Radio Vanuatu is now using 7250kHz for daylight transmission, heard up to 0800 and on one occasion through to 1100 — causing severe interference on Radio Nederland CIS relay. The station is also operating on 3945kHz. ❖

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind New Zealand Daylight Time. ❖

FORUM

Conducted by Jim Rowe

No, the EMC Framework isn't intended to stifle project construction!

Quite a few people have responded to some of the topics we've discussed here recently, so this month's column is a 'tying up loose ends' mixture. There's a response from the SMA confirming that their new EMC Framework isn't intended to crack down on electronic project construction, a couple of interesting letters following up on the topic of compact disc compatibility problems, yet another about Austel and its adminstration of the Telecomms Act, and also one prompted by Tom Moffat's recent article about fax modems — claiming their performance leaves a lot to be desired.

In last month's column, you may recall, I published a letter from Mr Terry Morley of East Victoria Park in WA. Mr Morley was quite concerned about the implications of the SMA's new EMC Framework, with regard to electronic projects of the type described in this and other magazines, and also the kits for these projects sold by our advertisers. (Mr Morley also seems to have sent similar letters to other magazines.)

At the time, I commented that my understanding of the EMC Framework — gleaned from both the SMA's press function when it was announced, and later discussions with its Radiocommunications Standards Manager Ian McAlister — was that the new regulations applied only to complete manufactured products, offered for sale in significant quantities. It seemed very unlikely that it would have any adverse effect on hobby electronics projects or even small-scale manufacture, at least in the short-term future.

While I was preparing the February column, I tried to get an official response from the SMA to Mr Morley's letter. And although the SMA was happy to provide such a response, it hadn't actually arrived by the time we had to go to press. Murphy's law came into operation, and the response arrived a couple of days too late.

This being the case, I thought we'd use it to kick off this month's column. It came as a fax from James Galloway, one of Mr McAlister's SMA colleagues, and here's what he wrote:

Thank you for your recent advice concerning views expressed by some of your readers over the EMC Framework. Perhaps the best approach to the issues raised is to clarify the status of the 'Information for Suppliers' booklet, and the process the SMA has adopted in developing the EMC Framework.

(The specific concern of products supplied in kit form is easily dealt with. As the framework is aimed at finished products that are available on the open market, they are excluded.)

The Information for Suppliers booklet is just that: an information booklet. It is not the EMC regulations. The booklet was developed in consultation with industry, but clearly those sections of industry which had the means and organisation to be part of a public consultation process. In view of this it was released and advertised in journals such as Electronics Australia to give others the opportunity to comment on any matters of concern.

The SMA set an 18 month period from the publication date of the booklet (June/July 1995) to the planned enforcement of regulations (January 1997) to accommodate this.

As a result there has been feedback from suppliers who would not otherwise have been a position to do so. This has led to a more realistic understanding of the issues affecting small suppliers and low-volume suppliers. It has also meant that sectors with inherently difficult technical problems have been able to put their views forward. As a result we are now in a better position to meet their circumstances, while at the same time not compromising the SMA goal of limiting spectrum pollution.

The regulations governing EMC will be finalised in the voluntary stage of the framework (1996-1997). The main features will be those in the Information for Suppliers booklet, along with any necessary amendments. Your readers may wish to contribute their views, particularly on issues to do with low-volume production, low risk devices and testing. Any views expressed cannot be accepted uncritically, but the SMA remains committed to achieving a manageable framework with minimal cost and disruption.

I welcome the opportunity to respond to any further inquiries you may receive, and trust that there will be some opportunity to explain in greater detail the operation of the EMC Framework in Australia.

Well, there you are — it's reasonably official. There seems to be no cause for concern regarding home-brew electronic projects or the sale of electronic kits, at least for the present. Even small 'bespoke' and other low-volume manufacturers of electronic equipment seem unlikely to be caught up in the expensive EMC testing procedures, for the short term at any rate. My thanks to Mr Galloway for sending this reassuring message, and we will try to run an article explaining more about the EMC Framework, in the near future. I'm sure everyone will agree that in principle, keeping the electromagnetic spectrum as 'clean' as possible is just as important as tackling any other kind of pollution.

At the same time, I suspect that small manufacturers like Mr Morley would be well advised to respond directly to Mr Galloway's invitation to contribute their views. There's always a risk in situations like this that Government authorities like the SMA will be influenced unduly by views expressed by the largest firms, because these are fewer in

number (and therefore easier to deal with) and organised in a similar way. But because large firms often have much greater resources than the smaller players, regulations that *they* may find acceptable can be quite crippling for those with more limited resources.

So if small manufacturers and kit suppliers want to try and make sure that the EMC Framework regulations *don't* gradually make their lives more difficult — perhaps by default — they should probably take this opportunity to make their views known. Bureaucracies have a habit of taking silence to be implied acquiescence, don't they?

CD compatibility

Now let's move on, from electromagnetic compatibility to compact disc compatibility. You may remember that we've published a number of letters on this topic over the last year or so, including one in December 1994 from Gerard Lawrence of Batemans Bay in NSW, another in March 1995 from Fred Thorpe of Narrabeen in NSW, one in July from Dr S. Frank of Berwick in Victoria, and finally one in December from Anthony Chidiac, a recording industry executive in Bundoora, Victoria. It's a topic that has obviously aroused quite a bit of interest.

Well, I've had two more responses and I think you'll also find them of interest. The first comes from Keith Walters of Lane Cove in NSW, who has contributed to the magazine at various times in the past. Here's what Mr Walters offers this time:

I refer to the problem mentioned in the December 1995 Forum, concerning CDs that won't play on some machines. I have had some experience of the matter myself.

Recently I gave a friend an old Sanyo CD player that I had no further use for. Never having owned a CD player before, she immediately went out and bought a large number of CDs, a substantial portion of these being of the 'five dollars each or five for twenty dollars' variety. I don't know where these things come from, as the documentation is pretty minimal, but I suspect they originate in China.

Anyway, most of the cheap CDs simply refused to work on the Sanyo — it couldn't even find the track index. But every one of them played perfectly on an extremely cheap and nasty CD ghetto blaster I just happened to be working on at the time...

I also tried them on a somewhat better (but still not overly expensive) midi hifi system, and they all worked on that too.

Suspecting dust on the laser diode, I opened up the Sanyo but there was no sign of that. So I tried loading one of the dodgy discs while the cover was still removed.

The problem was then immediately revealed — the disk wasn't dropping all the way down over the spindle. (The laser focus servo was just about jumping out of its mounting, trying to track the disc on a 30-degree angle!)

My first thought was that there was some sort of misalignment of the loading mechanism. However that wasn't it; the CD simply refused to fit onto the spindle, because its #@?!!&! hole was too small!*

Now the Sanyo was about nine years old and wasn't a particularly cheap model, so they seemed to have gone to some care with the mechanical construction of the loading tray. In particular the spindle was machined brass and looked like it was made to close tolerances. The one on the ghetto blaster, on the other hand, was just moulded plastic!

I suspect what's happened is that when the manufacturers originally started making CD players, they went to a lot

of trouble to minimise the amount of work the tracking and focus servos had to do, by manufacturing everything to very close tolerances.

However it probably soon became apparent that the CD medium was far more robust than they'd anticipated, and that improved servo electronics could economically cover for a multitude of sins in the mechanical design. Thus they moved to the all-plastic mechanisms almost universally used today.

They probably also encountered the problem of out-of-tolerance holes being too tight a fit, so they made the spindles a bit smaller! This would result in a certain amount of disk 'wobble', but as mentioned earlier, the focus servo seems able to cope without problems.

On closer examination, I found that the holes hadn't been stamped out cleanly — there was certain amount of plastic swarf that was probably binding on the brass shaft.

I eventually solved the problem by running some fairly coarse sandpaper around the inside of the hole. Other methods, such as scraping with a knife blade were unsuccessful, due to the extremely brittle nature of the polycarbonate material.

Thanks for those comments, Keith; I imagine many readers will find them as interesting as I did. Most of us have seen those el-cheapo CDs (some of which are on offer in one of my local 'bargain' stores for as little as $2.95 each!), and like you, we've wondered if they're really 'pirate' pressings from those notorious factories in mainland China. I suppose that it came as no surprise to hear that some of them cause trouble, especially with an older CD player designed to play 'full spec' discs.

You may well be right, in claiming that CD player designers have opted to rely on improved servo electronics to cover some of the limitations in the mechanical design of their latest models. It would be understandable, I guess, in view of the enormous competition and cost pressures in this market.

It was interesting to learn that the main problem with those non-playing cheap discs was a relatively simple physical incompatibility, between the disc holes and the player spindle. As you say, though, even knowing the cause of the problem doesn't make it easy to solve — thanks to the brittle nature of polycarbonate material, and the need to retain reasonable hole concentricity while enlarging it...

Moving on, our second letter on the topic of CD compatibility came from Mr A.N. Brooks, of North Mackay in Queensland. Here's Mr Brooks' contribution:

From time to time something in Electronics Australia gives me food for thought.

In 'Forum' December 1995, page 42, about 65% down column two (Ed: in Mr Chidiac's letter), *[I find]: '...Canadian group. The first batch had a 50Hz sinusoidal wave, not apparent in the Master'. There appears to be no exhaustive investigation of where this 50Hz anomaly originated; it seems it was not in the 'data' when the Master arrived in the country, and if it had been, surely it would have been 60Hz, which I guess to be the Canadian mains frequency. But the story goes on, 'the new batch was derived from a CD pressing sourced from the first batch of the original CD pressing made in Canada.' Perhaps this was done as a matter of expediency.*

In column three on the same page, about 90% of the way down, is the story of a problem CD (Ed: the one owned by my own parents, as it happens)*: 'their ...CD player... will play any of their existing collection... but refuses to even recognise a new one they recently bought'. I had this problem with one or two CDs, and on return to the music shop, they were able to demonstrate that the offending disc would play OK on their machine. One way I tried, with success sometimes, was to insert the CD, and then select a track other than the first; then selecting the first track, the CD played OK. Your explanation of tolerances is probably correct, but it's only the purists who seem to investigate such problems to some finality.*

Something quite different: again on page 42, third column 80% down: 'Perhaps some of the other recordings aren't quite as zealous as Mr Chidiac...'; the word 'recordings' seems out of context; is this the result of desktop publishing, and the disappearance of proof-readers?

Thanks for your comments too, Mr Brooks. And dealing with your last comment first, yes — I suppose the typo concerned *is* the result of desktop publishing and the disappearance of official proof readers. Fairly obviously I should have typed 'record producers' instead of 'recordings', and although we have a system where at least one other staff member always reads everyone's page proofs to try and pick up mistakes like this, the odd one still manages to slip through from time to time.

Considering how few people are involved in producing a magazine like *EA* nowadays, though, I don't think we do too badly — do you? The days of having separate proof readers are long gone, of course. From memory, we haven't had them for about 15 years.

Regarding your comment about Mr Chidiac's 50Hz hum, I must confess I had assumed he was implying that the hum had crept in during a digital-analog-digital transfer, by a local disc manufacturer. This seemed to be a reasonable assumption from his letter. Presumably the lack of either 50Hz or 60Hz hum on the new batch of discs was due to a direct digital transfer from the original Canadian recording.

My understanding was that Mr Chidiac merely offered his experience to support the theory that hum and other artifacts could creep into locally pressed CDs, as a result of an analog step in the transfer process. Like him I'm not exactly sure why it is necessary to use an intermediate analog stage — a direct digital transfer is surely possible nowadays, and should obviate the sort of problems that Dr Frank reported.

I'm sorry you seem to have found my explanation of 'tolerance variations' unsatisfying with regard to the reports of disc-player incompatibility, but like many people I really haven't had the time to 'investigate it to some finality'. Perhaps one of the 'purists' you refer to may have the time to do so, and let us know their findings.

Austel: discretion or no?

Moving on again, as mentioned earlier I have another letter on the topic of Austel and its administration of the Telecommunications Act — especially with regard to modems, computers and all of the other items that the Act seems to cover in theory, but may or may not be deemed to cover in practice, depending upon who you talk to.

This letter came from Ms Kathy Gluyas, who is managing director of G.G. Communications Engineering, of Donvale in Victoria. (It's nice to get a response from a female reader — we know there are some, but they don't often make their presence known.) Here's what Ms Gluyas has to contribute:

Having been a reader of Radio and Hobbies, Radio, TV and Hobbies, and Electronics Australia I would say I am qualified as a long time reader of the ongoing publication. When working for

Max Hull at William Willis and Co I meet John Moyle and Neville Williams. Who knows, I might meet you one day.

I am involved with Austel these days in getting approvals for my own equipment and on occasions other manufacturers or importers. I read your article in Forum with some interest, and can only agree with your comments. My experience is that generally Austel doesn't interest itself outside of making sure that the signal applied to the network doesn't, or can't, damage the network. Hence, provided devices cannot put tones onto the network because they go through an approved filter (i.e., a modem) and cannot put dangerous voltages on the network because of an approved line isolation unit or whatever, they are ignored.

It is true that they could apply your argument to computers, but they don't. It was rumoured that they were going to, but computer interests apparently made very loud noises. The same thing applies to security systems that are ultimately connected to the network. By and large, though, Austel reacts to adverse reports from the community. A small note... you did of course test your off-hook alarm on a PAX that was not connected to the network?

A note for Neville. I am finding his series 'When I Look Back' most enjoyable. The articles on Vic Harris in particular. For many years I used his pickups; I've had two arms, including an 'Equidyne' and three heads, a 'C', 'D' and 'L'. The 'L' was a stereo head. How about a line on Max Hull? That would be fascinating. Having known Max from 1955 until he died leaves me with no doubt about his importance to the PA industry and amateur radio.

Keep stirring, Jim. A lot of people who matter read your articles. Many thanks.

And thank you for your own comments, Ms Gluyas. I guess I'm still not convinced about Austel's lack of interest in computers and other related items, though. As I noted last month, there still seems to be a lot of confusion about whether or not the PSTN and hence the jurisdiction of the Act does indeed end at the modem or other LIU.

The Act itself seems to imply that the network *does* extend beyond that point, and in fact almost indefinitely. And although as you say Austel sometimes seems to quietly 'ignore' some of the weirder aspects of the Act and use its discretion, at other times it doesn't. All of which leaves many of us rather confused!

Thanks for your kind words about Neville's 'When I Think Back' column, and I gather that he has already contacted you for help in preparing a future article on Max Hull. That should make interesting reading, in due course.

Fax modem performance

And for our final contribution this month, I'd like to present the following letter. It comes from a reader in South Australia who has supplied his full name and address, but has asked for it to be withheld to prevent any embarrassment with his employer. As you'll see, it's basically a response to Tom Moffat's article on fax modems, in our September 1995 issue:

After reading Tom Moffat's column on Fax Modems in the September issue with concern, I feel compelled to give my two bob's worth and raise some doubts on the overall integrity and reliability of these types of product.

I am an engineer/technical support and training officer for a well known Japanese facsimile machine manufacturer, and have been involved with their and other manufacturers 'dedicated' facsimile machine products since their infiltration onto the Australian market nearly 10 years ago.

My concern is that there is an obvious lack of knowledge within the modem manufacturing industry here in Australia and a misinformed public, often resulting in both poor performance from their own fax modem devices, and disturbance to other facsimile operators.

Although the trend towards PC-based fax modems and software is in theory a practical and cost effective way for the average user to get online, the technology is currently not up to standard with the rest of the facsimile manufacturing industry. The problem is simply that these devices produce poor data quality as a result of their lack of adjustments for line signal level, frequency slope or equalisation, impedance matching, receive sensitivity and distortion properties.

A 'dedicated' facsimile unit on the other hand, apart from an integrated document scanner and printer unit, has the inclusion of special software and additional line interface circuitry to allow adjustable compensation for line losses (signal level), frequency slope (equalisation), line dependent distortions, receive sensitivity and line impedance. Needless to say that a dedicated unit has a far better performance and

(Continued on page 97)

THE SERVICEMAN

A mysterious audio intermittent — and from our first servicewoman contributor...

We achieve a historic milestone in Serviceman this month, with our first ever story from a servicewoman. (Perhaps we might soon have to change the column's name to The Serviceperson?) There's also a servicing story from our Vintage Radio expert Peter Lankshear, along with another about what was discovered when the antennas of an air force transmitting station were finally checked for SWR — with a secretly made bridge!

Some years ago, I was involved with a Rotary Club Careers Night at the local secondary college. During the evening I must have spoken about electronic servicing to 30 or 40 students, about half of them girls. Among the boys, five or six were quite interested in the trade and at least one, to my knowledge, has gone on to gain an apprenticeship and work in the industry.

On the other hand, the girls began by showing much greater interest, until they learned that they would have to work on energised equipment. I showed them that there was no way you could adjust the convergence in a colour TV without putting your hands inside a live set. That did it for the girls — they quickly lost any enthusiasm they might have had and headed straight off to the public service desk.

In each case, the girls said that they were scared stiff of electricity. Some admitted a knowledge of the subject, from their science classes, but all agreed that electricity was too mysterious and too dangerous for them to work with comfortably in the field.

Since those days, I have come to know hundreds of servicepeople all over the country and every one of them is a serviceMAN. I don't know of one qualified woman actively engaged in electronic servicing.

That's not to say there aren't any lady servicemen; just that I have never met or heard of any. There are a number of talented women in the engineering side of the profession, but as for hands-on servicing, the 'servicewoman' is unheard of — until now.

(You might have guessed that all of this was leading up to an unusual story. You weren't wrong!) Our next contributor is Kathryn Gluyas, of Doncaster East in Victoria. Kathryn has the honour of being the first ever female contributor to 'The Serviceman'.

I have in my files almost every edition of *EA* and its predecessors since 'The Serviceman Who Tells' returned to the magazine in April 1947. In more than 570 Serviceman columns, I cannot find a single reference to a lady service technician. There can't be many other trades or professions in which women have such a low profile.

So, it is with more than usual pleasure that I hand the column over to Kathryn. Here is her story...

Might I, without fear, tread the hallowed grounds of electronics service and relate a story of an amplifier that didn't?

Having been engaged in electronics for many years, manufactured many amplifiers and put in countless church installations, I am accustomed to broken cords etc. But it is not often that the electronics breaks down.

Over two years ago I moved one of my amplifiers from a church that closed down, to my own church. All went well until about three months ago. I was away for the day and the stand-in operator reported that the amplifier stopped working, as if the power supply had failed — a slow fadeout. On checking up, I could find nothing wrong. It looked as though I might have an intermittent!

Nothing further happened for a month, then it failed again during a service. This time I heard a build up of distortion, then a slow fadeout over about two seconds. So during a lull in the service, I pulled the amplifier out, removed the cover, and prodded. This revealed nothing, but at least made the system work for the rest of the service.

But what was it? Back on the bench, it would not fail. I went over it thoroughly, checking for dry joints. (Yes, I admit to making dry joints — occasionally!) Finding nothing, I reinstalled the system and waited for the next service.

The following Sunday I went to Church armed with a DVM. The amplifier failed again at precisely 10am (the beginning of the service) and a quick check showed the fault to be in the vicinity of the tone control, an area I had begun to suspect because of the distortion associated with the failure.

Having had trouble previously with a batch of pots going to ground on one side, I prodded the bass control pot and the system came back to life. Gotcha!

All went well for the rest of the service, then it was back to the bench and appropriate surgery on the offending pot. I ran the amplifier on the bench for a week and there was no sign of trouble. So I reinstalled the set in the church and ran it for two hours while talking to a friend. It was faultless; but on Sunday, at 10am, it failed again...

Off with the cover, prod and poke —

and Aha!, a sensitive electro. I could make the sound come and go, but my confidence was sapped. Later, as I replaced the capacitor, I wondered if I had lost the plot. I was rattled. The amplifier then tested perfectly with no trace of its previous sensitivity, yet something bugged me.

So next Sunday, I put the CRO in the car. Right on time, at 10am, it failed again. It seemed that there was some kind of clock on the job. Was it a CBer? A ham? What was happening?

I plugged in the CRO and traced the signal, much to the amusement of fellow worshippers nearby. This time I was able to pin down the break in the signal. There was an input to the tone control IC, but no output although all voltages were correct.

I pulled out the offending card and bridged the motherboard for the rest of the service. Back in the workshop it wouldn't fail, but this time I was positive it was the 741 IC; so in went a new one. On test, the amplifier sounded better than it had done for months. Wishful thinking? I don't know. But we have had one faultless Sunday so far!

Thanks, Kathryn. Your story is welcome on two grounds. One I have already laboured at some length. The other is that we seldom get stories on audio subjects; VCRs and TVs providing far more topics these days. Even as I delved back through the old old magazines, as mentioned earlier, I couldn't help but notice a relative lack of purely audio stories.

It seems that right from the start of the Serviceman column, radios, then TVs and now VCRs have provided proportionally more stories than have PA or stereo systems. Even battery chargers once got a better run in the column than did audio subjects.

So, Kathryn, your story goes a long way to redressing the balance. Thank you, and I hope we will hear from you again.

(Hold on — what *was* the association with 10am? Did I miss something?)

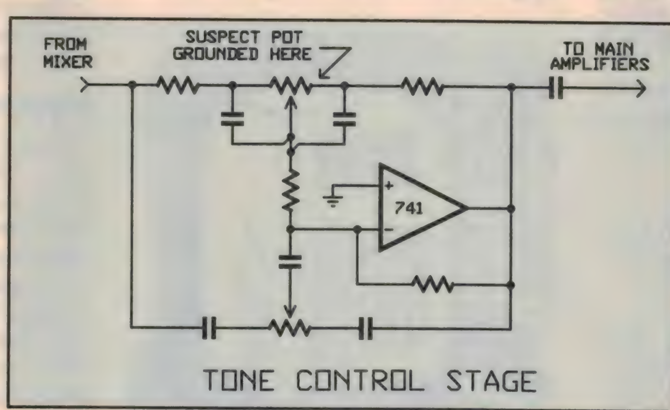
A *localised* hum

Now we come to a story from a contributor who is very well known to readers of this magazine, although he is quite unknown in this column! I refer to Peter Lankshear, author of the popular Vintage Radio column. In case you didn't know, Peter lives in Invercargill, New Zealand and is (or was) actively engaged in service work for many years. His vintage radio interests are a retirement hobby, but even now he can't resist the lure of the soldering iron and multimeter. Here is his story of domestic bliss, rudely interrupted by electronic mayhem...

One of the benefits of reaching senior citizen status is that just occasionally you can put your slippers on and enjoy a pleasant winter's evening by the fire, reading, watching TV or whatever without feelings of guilt about unfinished jobs and projects.

Some time ago, my wife organised the delivery of a couple of adjustable easy chairs, which were strategically positioned to enhance the Darby and Joan situation by providing the maximum degree of convenience and comfort.

The arrangement worked beautifully, but for one unforeseen problem — and I suspect, one that other readers will have experienced too. You just get nicely installed and the phone rings, completely ruining the scene of domestic relaxation.



The basic circuit of the tone control card that forms the basis of Kathryn Gluyas' story this month.

Some years ago I rewired the domestic phone system so that there are jack points in several strategic locations — office, workshop etc, (including one vital phone right outside the shower door!). There is, of course, a phone in the living room and although situated ideally for daytime activities, it is not within reach of our easy chairs.

I considered installing yet another phone jack, but it would not be easy. Anyway, two points in one room is a bit over the top and furthermore, one would have to remember to plug in a phone and then risk tripping over a trailing cord.

The obvious solution was a cordless phone, which would present no installation problems. Telecom's jack point is situated near a mains socket and there was a suitably unobtrusive location for mounting the base unit. A suitable phone was set up, and from my chair, I found that it worked most satisfactorily.

However, my smug satisfaction vanished the first time I passed the handpiece to my wife. "Can't use it", she said, "it's got hum!" (She is very discerning about audio quality, which is as a technician's spouse should be).

From where I sat, there was no hum audible, but long ago I had learnt not to ignore her observations. And sure enough, there was a pronounced modulation hum just in a small area around her chair. Elsewhere in the room there was no problem, but on checking around I found that it did appear in several other parts of the house.

Experimenting with the telescopic aerial lengths had little effect, and neither did turning on and off lamps and appliances. The only positive indication was that the hum only appeared when the base unit was generating a carrier. Apparently, the house wiring was re-radiating the base unit's signal and in the process, was managing to modulate it.

A check with a signal generator showed that the base unit transmits at around 35MHz and therefore the 50cm aerial, considerably shorter than a quarter wavelength, operates as a Marconi aerial, using the telephone fixed wiring as a counterpoise earth.

As rerouting the house wiring is out of the question, the next best thing would be to keep the RF out of the mains. Hopefully, persuading the RF to use the telephone wiring only would do the trick.

One solution would have been to insert RF chokes in the plug pack supply leads. The problem was that the plug pack is sealed, and external chokes would be inconvenient. Fortunately, the supply lead from the plug pack has sufficient length to allow a dozen turns to be wound on a piece of ferrite aerial rod, which can then be stowed inconspicuously.

This was done and the cure is complete. All traces of hum are gone, but now — how do you persuade family and friends to time their calls to coincide with the TV commercial breaks?

I'm sorry, Peter. I don't know how to stop the interruptions. Perhaps an

answering machine might be the answer. (Oops!)

Actually, I'm not worried by TV interruptions — the calls are often more interesting than the programmes — but I don't care to be interrupted when I'm in the bathroom. Your plug outside the door is one answer. Mine is to take the cordless phone with me. (I'm glad we don't have video phones yet. I am NOT a pretty sight as I step out of the shower...)

Anyway, back to your solution, Peter. The power cord around a ferrite rod is not a new idea, but it's usefulness is very patchy. The only time I've had a real success was in cutting radiation from an old computer. It was playing merry hell with our most popular TV channel, and I was forbidden to go anywhere near the computer while the family was watching TV. Ten turns around an eight-inch rod provided a complete cure.

Thanks for the story, Peter, and I'd like to think we'll have more from you in these pages.

SWR not allowed

It seems we can't get away from Kiwi contributors — our next story also comes from the Shaky Isles.

It's from Graham Cheer, of Tauranga, and is the second of a group of three interesting stories from this contributor. It seems that Graham has had a very varied career in electronics. His first story was about repairing computers. For this one, he is into transmitting antennas and for the next — well, you'll have to wait and see!

This story goes back to about 1970 when I was a Sergeant in the RNZAF and in charge of the transmitting station at an Air Force base. We had installed old and new transmitters in a newly constructed transmitter hall, and I decided that it would be a good idea to complete the installation by giving the antennas a thorough check out.

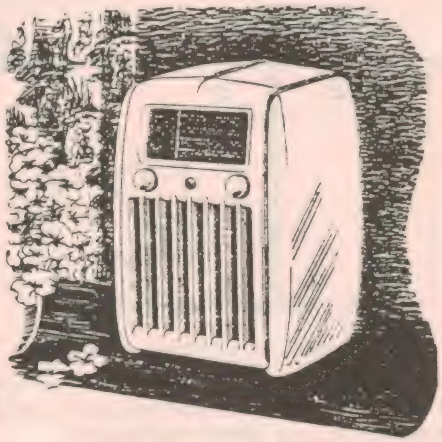
We had a mixture of horizontal folded dipoles and vertical monopoles which had been subjected to regular physical checks and repairs. The only other thing we needed to do was a proper electrical check with an SWR bridge.

Unfortunately, we had not been allocated a bridge, nor were we allowed to have one — even though we had much more expensive gear such as frequency counters and a spectrum analyser.

I decided to get up to some skullduggery, by ordering the requisite parts under the pretence of using them for repairs to the transmitters. Eventually the parts arrived and were built up into the SWR bridge. This was calibrated and mounted into the antenna patch rack, where it became part of an authorised item and no longer an illegal instrument.

We were now able to check the antennas and found that the dipoles were all OK but some of the verticals were very poor. We traced the problem to poor earthing at the base of each aerial. We drove new earth spikes into the ground (the old ones were badly corroded) and this fixed the problem for all except one antenna.

This particular aerial was supposed to be used at a frequency in the lower 3MHz region. A physical inspection of the aerial appeared OK, but when compared with the other verticals it seemed that it might have been cut to the wrong length.



The neat little AWA 'on its end' radio featured in this month's last item. Its unusual design made the chassis very unstable when out of the case.

We calculated its theoretical length and found our suspicions correct — it was about five metres short. A probable reason for this was that the masts supporting the aerials were only 22 metres high and someone, in their wisdom, had cheated and cut the aerial to fit the masts. It so happened that the transmitter seemed to load OK into the shorter aerial, but its efficiency was obviously compromised.

Our first thought was to base load the aerial, with a coil which we calculated, wound and mounted at the base of the aerial. Although the coil was weatherproofed, we found that it affected the electrical length of the aerial with changes in the weather.

We studied the 'Good Book' on aerials and decided that perhaps an inverted 'L' could be more appropriate, with the vertical part of 21 metres and the remaining four metres at the top strung horizontally across to another mast. After this, we found the aerial behaved perfectly in all weather conditions.

I don't know how long the short aerial had been in use, but I suspect it was in the vicinity of 20 to 30 years! And the problem would have been found that long ago, if the authorities had been less dogmatic about what equipment we could and could not have.

Well, Graham. I can sympathise with your feelings back then. An SWR bridge seems to be such a small item of equipment, yet in that case it would have been of really inestimable value. But I suppose the authorities never realised how much more efficient or reliable the system was after the treatment, so they would never see the value of the gear you so cleverly built up (and camouflaged!).

Thanks for the story Graham, and as mentioned, there'll be another one in the near future.

Mysterious buzz...

Now for a story from my own workshop. My bench is rather under-used these days, but like most servicemen, I find it almost impossible to put down the soldering iron for the last time.

Do you ever do some simple thing without thinking about it, only to find later that it has caused you untold trouble? I'm notorious for it, and I've spent hours chasing faults that didn't exist in the first place! Here's a case in point...

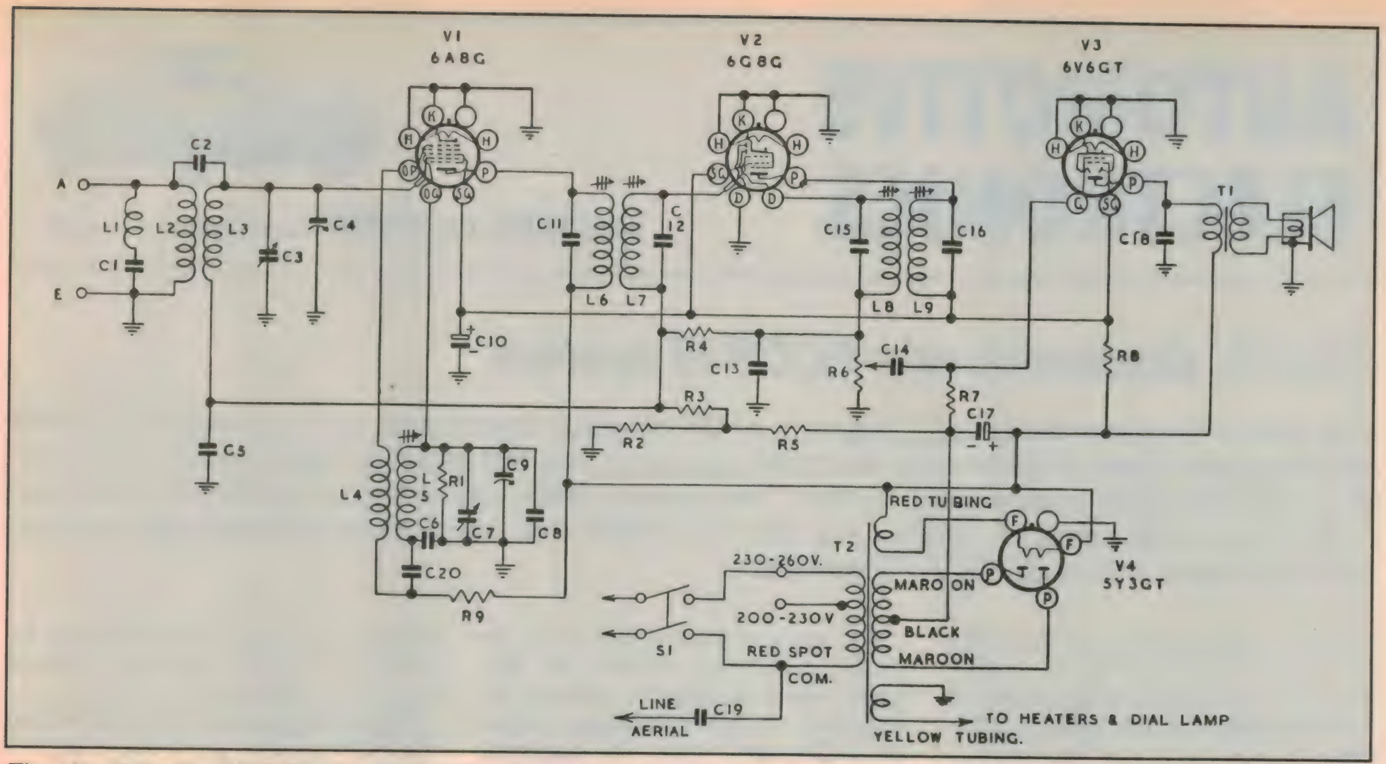
I have a special bench that I made up for working on video cassette recorders. It has a shelf on which I keep the CRO, pattern generator, a colour monitor and various tools and accessories that make the job of servicing VCRs easier.

On the underside of the shelf I have fitted a low voltage fluorescent strip light. I selected the smaller unit because it only projected below the shelf by about four centimetres, rather than the 10cm of a more conventional fluoro. In the years since I made up the bench, it has worked well and has never given me a moment's trouble. Until today, that is.

My son brought in a four valve mantel radio of unknown brand or vintage. His girl friend's mother wanted to know if I could fix it, and I've never been one to refuse a challenge.

I gave the set a quick examination in the kitchen and determined that there were no obviously damaged parts, nor any short circuits on the mains or high tension lines. Then I switched it on.

As the set warmed up, it gave out a loud buzz. It wasn't hum in the usual



The circuit for the AWA 520M mantel radio. There are not a lot of components in the chassis, and it looked quite empty after the big old paper capacitors had been replaced with modern miniature types. The most likely cause of the trouble was C5, below the aerial coil at the left hand end.

sense, but seemed to be linked to the mains in some way

Then as I tuned over the band, the buzz became a whistle then back to a buzz, in a typical heterodyne fashion. There was only a faint trace of station in among the birdies.

Under the chassis, I found a variety of capacitors, including the old AWA 'moulded mud' variety plus several later but still very old Ducon paper capacitors. It was clear that the set had been worked on in the past, but so long past that even the replacement parts were into their 'time on' period.

So I took the set down to the workshop and in the absence of anywhere else to put it, parked it on the VCR bench. (Since I no longer work every day in the workshop, it doesn't get tidied as often as it should and at the present time is in a disgusting mess!)

The whistles that I had heard earlier are usually due to a faulty bypass capacitor somewhere in the front end of the receiver. Without a circuit diagram it was going to be difficult to localise the culprit. The caps were all so old that it was better to replace the lot, shotgun fashion — which I proceeded to do.

(Fortunately, these ancient components are all so large that printing their values on the body was quite easy. Most manufacturers did this, some on the paper wrapper or in the case of the AWA mud type items, moulded deeply into the body of the capacitor. I thank those old designers for their thoughtfulness!)

When I had finished the replacements, I gave the set a quick re-alignment then connected the aerial. But wouldn't you know it? Those heterodyne 'birdies' were still there.

To cut a long story short, I tried every trick I knew to track down the cause of the whistles. I must have spent an extra two hours on the set, replacing replacements and twiddling and tweaking, but nothing seemed to be doing any good.

Then without warning, and for no reason that I could see, the fluorescent tube fell out of the lighting fixture under the shelf. It wasn't the sudden darkness that startled me — there was plenty of other light in the workshop. It was the change of tone from the receiver that was totally unexpected.

I replaced the tube in the fixture and the sound changed back to what it had been before the event.

Quite suddenly, I realised that the source of the noise I had been seeking was in the fluoro's power supply — it was some kind of cheap switch mode supply and it was radiating happily into any radio brought near it!

I checked with a couple of portable sets and each of them whistled merrily when brought within about a metre of the light fitting while it was on. With the light switched off, the radios were as silent as the tomb. The little four valve mantel was working as well as it had ever done, and I had no qualms about returning it to its owner.

I have serviced hundreds of VCRs and quite a few small TVs on that bench, and never once has the radiation from the fluoro caused any trouble. And this time, if I had cleared a space on the normal bench, I wouldn't have had any trouble either. We live and learn, don't we?

Incidentally, I was looking through a collection of old service manuals when I came across the full manual for this very model. I had suspected that it was an AWA set, because of all the AWA capacitors, but there was nothing on the cabinet to confirm it. The only identification was the model number 520M. As it turned out, it was an AWA model and the only thing now in doubt is the year of manufacture. Perhaps I should ask Peter Lankshear...

Finally, I don't know whether the circuit diagram would have been of much value since all the capacitors (condensers, in this case) needed to be replaced anyway. However, I suspect that it was C5, a bypass on the AGC line that was the prime culprit.

Well, that's all for this month. If the fates are willing, I'll be back with some new stories next time. ❖

The VL Commodore's ECCS III system

This month my good friend Jon Loughron, of Melbourne's Injectronics (a firm specialising in the diagnosis and repair of automotive electronic systems), has written an 'in depth system overview' of the ECCS engine management system. This system, itself a derivative of the BOSCH Motronic, is fitted to a wide range of vehicles and Jon has written this story around the particular configuration as found on the '86-88 VL Commodore.

The VL Commodore uses the ECCS III control system and has an in-line, three litre, six cylinder multipoint fuel injected engine that has a standard distributor type electronic ignition system. The ECCS III is a full engine management control system, which means the electronic control module (ECM) controls fuel delivery, ignition timing, ignition dwell, idle speed and closed loop mode — to maximise power, stabilise idle under varying load conditions and also minimise harmful exhaust emissions.

The ECM is a microcomputer that consists of a 6801 microprocessor, RAM, ROM, and associated circuitry for input and output, signal conditioning (A to D, switch debouncing and filtering) and sensor power supply. Being a digital system it also has diagnostic capabilities, so that the technician can interrogate the system if problems arise with the engine management system.

The unit is located to the left of the passenger footwell, behind the kick panel. Once the panel is removed the diagnostic screwdriver-adjust control and LEDs can be seen. The diagnostic 'screw' (potentiometer plus switches) on the side of the ECM can invoke four modes; two are diagnostic modes (closed loop and fault codes), whereas the other modes provide idle trim and code erasure.

Reading the codes or feedback information can be done by observing the two LEDs through the hole in the ECM case. The modes mentioned above will be discussed in more detail after a few system basics are covered. A list of inputs, outputs, power supply and ECM pin numbers are shown in Fig.1.

Power supplies

Pin 114 of the ECM is always live (battery voltage), even if the key is off. This is done so that fault details (even intermittent conditions) can be stored in memory and be retrieved later when necessary.

When the ignition key is switched on, the ECM grounds pin 6 and energises the EFI relay, which applies +12 volts to pins 27 and 35 of the ECM. The self-hold or 'self shutoff' function is implemented so that the ECM can clean (burn off) the element in the hot-wire air mass meter (AMM) after the engine is switched off.

The earth connections are self explanatory and need only the normal maintenance involved in any electrical/electronic system. Ensure they are clean, tight and free of any oxidisation. Both battery terminals, and all engine management connections, should also receive the same attention.

Self-clean function

When the ignition key is turned off, the ECM waits 5.5 seconds and applies 9V to pin 4 of the air mass meter for one second, which heats the measuring element to around 1000°C (burn off). The EFI relay is then de-energised, by removing the ground signal provided on pin 6, and the ECM turns off. Providing the coolant temperature is less than 115°C and the vehicle has exceeded 20km/h and 1500rpm, the burn off procedure is performed. Under normal circumstances the 6.5-second total delay time before shutdown will always occur, but the burn off operation depends on the previous set conditions.

Any dust or foreign substance on the sensing element can affect calibration and corrupt the output voltage. The air mass meter is a fairly sensitive device (air measuring-current between approximately 500 - 1200mA), so it is very

Inputs	Pin no.	Outputs	Pin no.
Crank angle sensor	8,17	Fuel pump relay	16
Air mass meter (load)	31	Ignition	3
Air mass meter (CO)	30	Injection	101-106
Coolant temp sensor	23,26	EFI relay (self shut off)	6
Oxygen sensor	24	Idle speed	2
Throttle postion sensor	25,18	Fuel pressure control valve	19
Park nuetral switch	10	Air mass meter (burn off)	12
Primary ignition	3		
Ignition on (key on)	34	**Power supplies**	**Pin no.**
Starter motor (cranking)	9	Battery supply (constant)	114
Air conditioning staus	22	Battery supply (self hold)	27,35
Vehicle speed sensor	29	Grounds/ earths	26,28,36,107 109,112,113.

Fig.1: Power supply, input and output pin connections for the ECCS III ECM module.

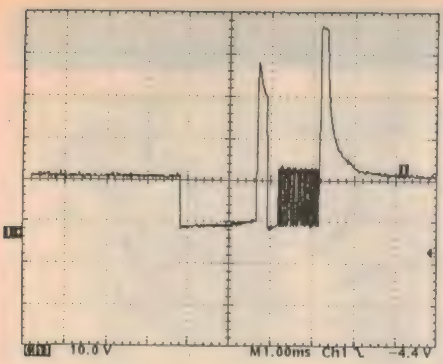


Fig.2: The injector current waveform. Following an initial 2ms pulse, a modulated current is to control AFR relevant to engine and load conditions.

important to ensure that burn off procedures occur. Burn off can be inspected visually or measured with a multimeter between pin 4 (AMM) and ground (negative battery terminal). If it operates as intended, it will extend the life of the air mass meter and ensure that it is clean and ready for the next start.

Fuel system

The fuel system consists of a fuel tank (obviously!) with an internal low pressure pump and an external main pump, plus damper, fuel filter, supply fuel line, fuel rail, six fuel injectors, a fuel pressure regulator (with vacuum port), fuel pressure control valve (FPCV) and the return fuel line.

The fuel pressure regulator is set to 250kPa and is connected to the fuel rail by two fuel lines. The regulator vacuum port is connected by a vacuum line, via the FPCV to the inlet manifold, so as to keep the applied pressure across the injectors constant.

The ECM can increase the fuel pressure by grounding pin 19, which operates the FPCV. This aids hot starting by disconnecting manifold vacuum and applying atmospheric pressure to the fuel pressure regulator port, therefore increasing fuel pressure. When the coolant temperature sensor exceeds 95°C and a crank signal (engine cranking) is sensed, the FPCV is engaged for the first few minutes of engine operation.

Correct fuel quantity is directly controlled by the ECM. Delivery is achieved via six 2.5-ohm injectors, which are electrically connected in parallel in two groups of three (pins 101-106). Each group has an output stage from the ECM.

The non-turbo auto ECM (3EA) operates both injector stages in a simultaneous mode, while the turbo (3TA) uses simultaneous and group injection modes depending on engine speed and load requirements.

To limit current through the injectors the ECM switches the injectors hard to ground for a short duration, approximately 2ms (Fig.2), then it switches to current control mode and modulates the control signal for the correct duration relevant to engine temperature, engine load, acceleration enrichment and various other engine conditions. Although this complicates the output stages of the ECM, it has three desirable effects. One is of course current control, avoiding burnt-out injector coils. Also no series ballast resistors are required — which has the added advantage that the full battery potential is applied to the injectors, therefore inducing quick operation.

The fuel pumps (main and pre) are controlled by the ECM via the fuel pump relay. When the ECM provides a ground on pin 16, the fuel pump relay operates and supplies battery voltage to the fuel pump. The fuel pumps will run for five seconds when the key is switched to the on position, and continuously while the engine is cranking or running.

Ignition control

The electronic ignition system consists of a distributor, rotor button, ignition leads, power transistor and only one ignition coil. Inside the distributor is the rotor button, to deliver spark to each cylinder, and there is also an optical trigger unit known as the crank angle sensor — which will be discussed in detail later.

Base timing is set in the normal manner, with a timing light and 12mm spanner, and is set to 15° BTDC at 700rpm. When setting the base timing, ensure that the engine is at operating temperature, the transmission is in park or neutral and air conditioning is off.

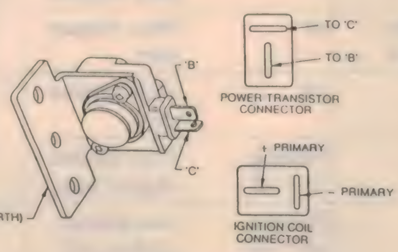


Fig.4: The VL ignition switching power transistor and its connector wiring. The base is connected to pin 5 of the ECM, the emitter to earth (chassis) and the collector to the negative side of the coil. (Diagram courtesy VACC).

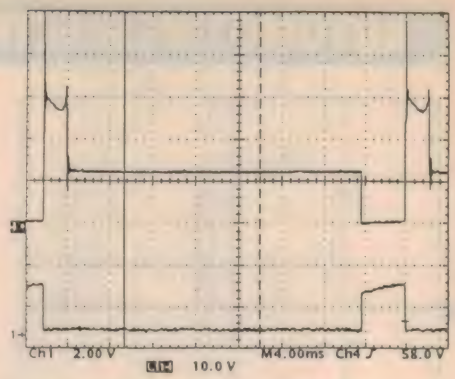


Fig.3: The ignition switching transistor's base drive signal (lower waveform) and the coil primary voltage (upper waveform).

Variations to ignition timing and dwell are controlled by the ECM. It provides the base drive for the power transistor (Fig.3), which is connected to the primary side of the coil — which in turn, via the secondary winding and distributor, provides the potential to ionise the relevant spark plug.

When testing the ignition system always be very careful. There are some very dangerous voltages in both the primary and secondary ignition system, and flesh is a relatively good conductor at these potentials (trust me).

The power transistor is mounted on the side of the distributor, and is connected as shown in Fig.4. Pin 3 of the ECM also samples the negative coil switching and provides a fault code if any discrepancy arises.

A quick method for testing the vehicle spark can be done by using a simple LED test lamp with an appropriate current limiting resistor (approx 1kΩ). With the ignition key off, connect a spark gap from the secondary coil lead (distributor end) to earth, pull the two-pin plug off the power transistor and turn it upside down.

Reconnect the two-pin plug — the bottom pin (base) should now be exposed and the transistor can now be manually switched, because control from the ECM is isolated.

Turn the ignition key on. Connect the LED tester to the positive battery terminal and tap the other end onto the exposed base. Spark should now be evident. If there is no spark, the power supply, ignition coil (primary winding 0.9 - 1.0Ω, secondary winding 9 - 10kΩ) and leads should be checked. If these test OK, then there is not much left except the power transistor.

NOTE: When connecting or dis-

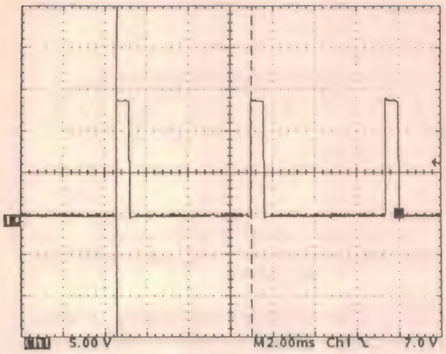


Fig.5: The idle speed voltage at the auxiliary air control (AAC) valve, driven from pin 2 of the ECM.

connecting ignition parts, always ensure the ignition key is off!

Idle speed

Idle speed is maintained by the Auxiliary Air Control valve (AAC). There are two other fast idle devices; one that responds when the air conditioning is requested, the Fast Idle Control Device, (FICD) and an air regulator bypass, used during cold start/warm-up periods. Both of these devices are hard wired through various switches and therefore not controlled by the ECM.

The AAC valve is controlled by the ECM and is basically a valve that bypasses air around the throttle plate. The more air that is bypassed, the faster the idle. It is connected between +12V and pin 2 (an open collector) of the ECM.

The resistance of the AAC valve is approximately 10Ω and it opens against spring tension driven by a 160Hz varying duty cycle signal (Fig.5).

Controlled idle speed is 700rpm +/-50rpm and base idle is set with the AAC valve disconnected and no load on the vehicle system — that is lights off, air conditioning off, transmission in neutral and vehicle at operating temperature. If idle speed is out of specification it should be set to 650rpm +/-50rpm by the idle speed adjustment screw next to the AAC valve (Fig.6). **Never adjust idle speed by the throttle plate screw on the throttle body!**

An idle trim can be achieved by adjusting the potentiometer on the side of the ECM. Turning the screw fully clockwise invokes the diagnostic mode. This leaves the first 90% of the potentiometer travel for idle trim and in this mode area the ECM will also report when the throttle position sensor is open, that the oxygen sensor is up to operating temperature and the mixture ratio feedback (closed loop information).

Closed loop mode

The ECCS III system is not unique by being a closed loop system; most late-model vehicles apply this technology. The base injection time is determined by various input sensors — the air mass meter, coolant temperature sensor (CTS), throttle position sensor (TPS) and oxygen sensor (O_2).

The air mass meter determines the quantity of air entering the engine (more air, more fuel). The coolant temperature sensor indicates engine temperature — a colder motor needs a richer mixture (similar to the choke on a carburetted vehicle), although the CTS will decrease its resistance as the engine warms up to operating temperature and therefore the ECM will lean the mixture off. The TPS is adjusted so that just as the accelerator is depressed the switch will open; the ECM recognises this change in condition and provides a short extra injection pulse for acceleration enrichment.

Apart from the air and coolant temperature being measured, the O_2 sensor monitors the exhaust gas; this is termed 'closed loop mode'. Closed loop mode is entered when the engine is at operating temperature and the TPS contacts are open (when the contacts are closed the ECM will be in idle mode and the idle mixture is determined by adjusting a screw on the air mass meter). So once the system is at operating temperature and we have our foot on the 'go' pedal, the ECM will enter closed loop mode and use the oxygen sensor signal to modify injection time so that the optimum mixture ratio can be maintained. This ratio is maintained (a stoichiometric ratio of approximately 14.7:1) to maximise engine efficiency and also allow the catalytic converter to operate to its maximum potential, so as to minimise harmful emissions.

The oxygen sensor is a Titanium ceramic (as distinct from the more common Zirconium) three-wire heated type sensor, and grounds

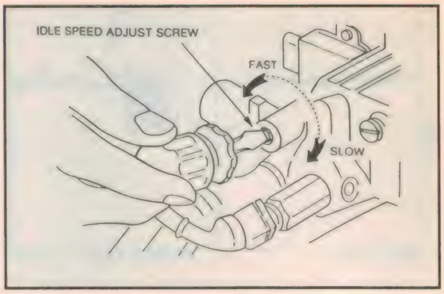


Fig.6: Idle speed can be set to 650rpm +/-50rpm using the idle speed adjustment screw, next to the AAC valve.

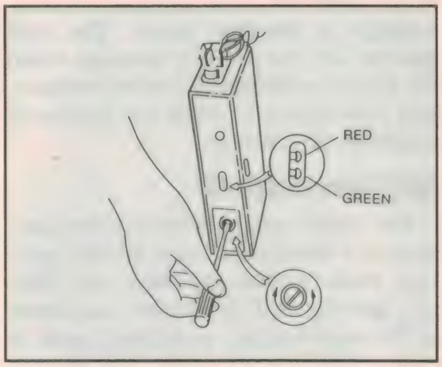


Fig.7: The ECM mode can be selected using the selection 'screw', a combined pot/switch on the side of the ECM module just below the diagnostic LEDs.

Green LED	Red LED	Function	O2 Sensor
off	off	No closed loop function	?
five flashes per second	on	Base mixture lean.	OK
"	off	Base mixture rich.	OK
"	Flashing on > off	Base mixture slightly lean.	OK
"	Flashing off > on	base mixture slightly rich.	OK
"	Synchronised with the green LED	Base mixture correct. (lambda = 1)	OK

Fig.8: The LED mixture codes (screw fully anticlockwise), and the meaning of the various fault codes.

Code No.	Red LED	Green LED	Malfunction
11	*	*	Crank Angle Sensor (CAS)
12	*	* *	Air Mass Meter (AMM)
13	*	* * *	Coolant Temp Sensor (CTS)
14	*	* * * *	Vehicle Speed Sensor (VSS)
21	* *	*	Ignition Signal (IGN)
23	* *	* * *	Throttle Pos'n Switch (TPS)
24	* *	* * * *	Neutral/Drive Switch (NDS)
31	* * *	*	Air Conditiong Status. (AC)
32	* * *	* *	Starter Signal
44	* * * *	* * * *	System Pass

The LED's flash for 2.4 seconds and the gap between codes is 4.8 seconds.

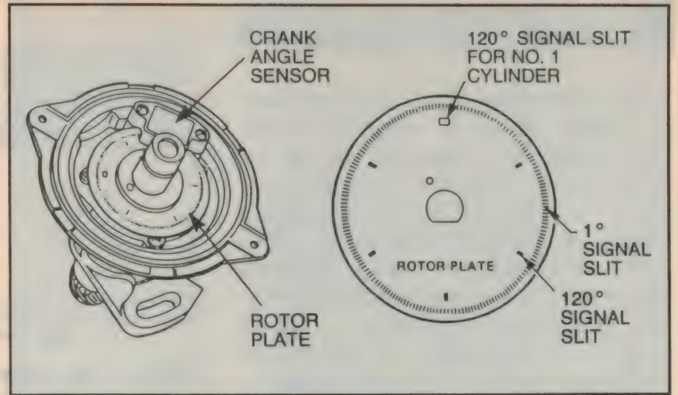


Fig.9 (left): The LED diagnostic codes (screw fully clockwise), and the meaning of the various fault codes. Fig.10 (right): The crank angle sensor (CAS) and its slotted rotor plate. (Diagram courtesy VACC.)

via its body. The red and white wires are connected to an internal heater element, with a resistance of 5 - 7Ω. (**DO NOT measure the sensor element — the black wire — with an ohmmeter as the current may damage the sensor**).

The heater element's +12V power is supplied by the fuel pump circuit, so power is only connected when the pump primes, the engine cranks or the engine is running. The heater element ensures quick and constant heating of the sensor and exhaust manifold temperature will also assist. At its operating temperature, above 300°C, the black wire becomes of interest; its output will oscillate between 0.1V (lean) and 0.9V (rich) at approximately 1.5 - 4.0Hz, when the exhaust gas reflects the optimum ratio. (See Automotive Electronics in the *EA* December 95 issue, regarding oxygen sensors.)

If the sensor's output voltage stays at one extremity for too long, the ECM will attempt to compensate by modifying the injection duration. If the ECM is unsuccessful in rectifying the mixture error, performance problems will start to become evident — such as heavy fuel consumption and rough idle.

The problem could be attributed to a faulty ECM, an input sensor (i.e., the air mass meter), a fuel delivery problem or maybe even the oxygen sensor itself.

When testing the O_2 sensor, the engine must be at normal operating temperature and run at approximately 2000rpm. Either a voltmeter or preferably an oscilloscope can be used to observe the sensor oscillations.

The oxygen sensor is not supposed to directly affect idle CO (carbon monoxide), however if there has been a continuous mixture error, then the fuel map that the ECM refers to will be changed and therefore idle mixture and stability will be seriously affected.

As mentioned previously, testing the mixture ratio feedback can be achieved by entering the relevant diagnostic mode and checking the ECM's diagnostic LEDs. To accomplish this task, the passenger side kick panel must be removed; once removed the diagnostic screw and LEDs can be seen on the side of the ECM (Fig.7).

Disconnect the throttle position switch and the AAC valve. Turn the diagnostic screw fully *anti-clockwise* and start the engine. (Note: the engine must already be at normal operating temperature.) Rev the engine to 2000rpm two or three times, under no load. Then let the engine return to idle. The green and red LEDs should blink on and off, **simultaneously**, more than five times in ten seconds.

If they do blink together, then the mixture ratio is correct. If not, further testing and adjustment will be necessary. Fig.8 shows the different LED combinations and what they mean.

The CO voltage level can be adjusted by turning the screw under the plastic cap (beside the connector) on the air mass meter. (When a new air mass meter is installed the CO voltage, between pins 1 and 6, is normally set to 3.6V). If the mixture ratio is incorrect and you are going to adjust the CO voltage, (richer anti-clockwise — leaner clockwise) remember to check the LEDs at idle after revving the engine.

It must be also noted that there are legal limits regarding the maximum amount of CO the exhaust gas can contain at idle. If mixture variations cannot be simply adjusted or are incorrectly set, it is imperative that the system is checked out thoroughly by a professional, with the appropriate test equipment — i.e., a gas analyser. So if you're in doubt, DON'T TOUCH.

The mid range mixture can also be checked by the method mentioned above, except the LEDs are checked while the engine is slowly accelerated to 2000rpm and kept there for a short time. After the mixture ratio is adjusted to the optimum value, stop the engine, reconnect the TPS and AAC valve, and ensure you then replace the plastic plug that covers the CO adjustment screw on the air mass meter (GMH part no. VS16400). Then replace ECM cover.

Fault codes

The system also includes a self test and reporting function known as the diagnostic mode. To enter diagnostic mode, turn the ECM screw fully *clockwise*. Once diagnostic mode is entered, the LEDs will flash and indicate a decimal number (the green LED indicates units and the red LED indicates tens).

As mentioned before, the ECM watches the inputs and has the ability to log permanent and intermittent faults in memory. Fig.9 relates the relevant sensor for the displayed fault code.

There are a few precautions that should be taken when using diagnostic codes. For instance there are some

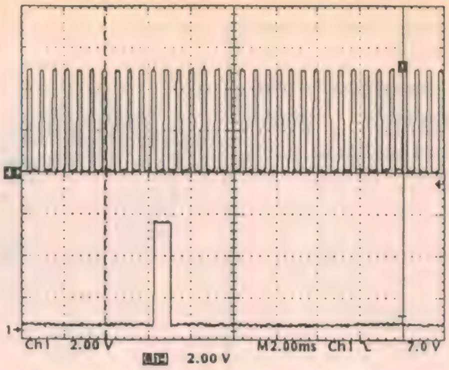


Fig.11: The outputs from the crank angle sensor, with the 'one degree' output signal at top and the '120 degree' output below.

codes that always seem to be logged. This can be explained by the fact that the inputs for the system are sampled continuously — so when the engine is started, several digital inputs do not change state. These include the TPS, NDS, AC status and VSS; and as the driver operates each of these inputs the ECM will clear the relevant code.

One way of checking the system (if the vehicle starts and runs) is to enter diagnostic mode, engage the air conditioning and take the vehicle for a short drive. Before you switch the engine off, check the fault codes. Code 44 is the pass code — unless the vehicle has no air conditioning fitted, when the pass code is 31. If a problem is still evident, erase the codes and repeat the test.

If the system does sense a problem, it will load the relevant code permanently into memory. The problem must be rectified, then the code can be manually erased.

To erase codes, turn the ignition key to the off position and ensure the diagnostic screw is in the fully anticlockwise position. Turn the ignition key to the on position and turn the diagnostic screw fully clockwise. Wait two seconds and return the screw to the full anticlockwise position. Wait two seconds again and turn the ignition key off. The permanent codes should now be erased.

When you have finished using diagnosis or closed loop mode, return the diagnostic screw to the middle of its travel and replace the ECM cover panel.

System triggering

Since the ECM controls injection, ignition and idle speed it has to know the crankshaft/camshaft speed and position. This information is made available to the ECM by the crank angle sensor (CAS), which is mounted inside the distributor.

The CAS is an optical device that consists of two channels, the 1° signal and the 120° signal. It has a set of infrared LEDs and photodiodes per channel. It also has a slotted circular plate that is mounted in the distributor on the shaft (Fig.10).

As the shaft turns, interruption of the light source occurs and the associated electronics in the CAS produce the switching action. The ECM must know absolute crankshaft position, so the plate has one wide slot to indicate the position of the number one cylinder.

The ECM provides a 5V pullup for each channel and when the slots in the plate align with the photodiodes, the CAS output stage is off and the signal is high (5V). Alternatively the output will be low (0V) when the photodiode is dark (Fig.11).

These units create quite a few problems, that are often intermittent. Normally a problem associated with a faulty CAS is a vehicle that intermittently cuts out, cools down for 15 minutes, then starts and runs for another unpredictable period.

Testing the sensor is relatively simple, and Fig.12 shows the approximate voltages when measurement is done with a multimeter. An oscilloscope can also be used and is probably preferable to a multimeter.

The pulse waveforms should have clean switching between 0 and 5V, with minimal rise and fall times. If there is no pattern, check the power supply to the sensor and all of the connections for oxidisation (a very common fault because of the low switching currents). If either of the trigger signals do not pull down from 5V, the sensor is faulty.

Well, that wraps it up for this month. As you can see the VL has a relatively complex engine management system; but with the self test modes and feedback information, hopefully the automotive tech's mental health remains OK and vehicle down time is minimised. Until next time, bye! ❖

Signal	Wire color	Engine running	ECM pin no.	CAS plug
120 degree	yellow	2.2 volts	17	5 volts*
1 degree	white	0.2 volts	8	5 volts*
power supply	orange	battery volts (+12v)	-	battery volts
ground	black	0.0 volts	-	0.0 volts

* CAS plug disconnected and the ignition key on.

Fig.12: Crank angle sensor test voltages as measured with a multimeter.

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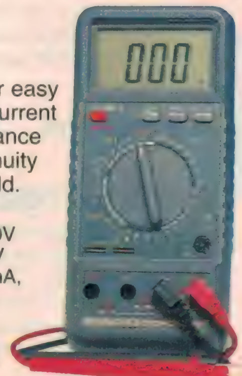

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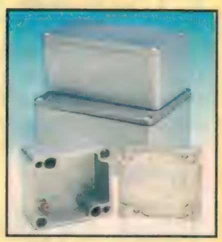

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Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

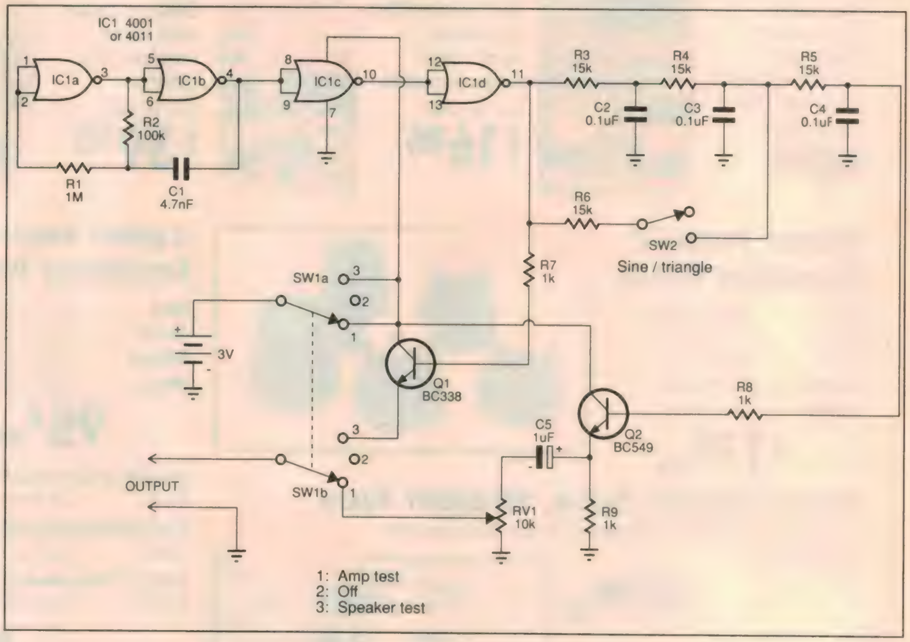
Handheld audio signal generator

This simple handheld audio signal generator was designed to aid musicians and audio technicians in testing speakers, leads, amplifiers and effects units.

IC1, a quad NOR gate, is wired up as a 1kHz square wave oscillator with C1 and R2 setting the oscillator's frequency. R3-R5 and C2-C4 form a low pass filter which gives a 400mV p-p sine wave from the 3V p-p square wave generated on pin 11.

The sine wave is then fed into Q2 to provide a low impedance output, with RV1 providing a variable output level control. With SW1 in position one, this sine wave is passed on to the output terminals and can be fed into any suspect amplifiers or effects units.

Position two disconnects the power to the generator, while position three will switch the 3V square wave on pin 11 through to the output terminals via R7 and Q1, which is suitable for driving loudspeakers directly. SW2 can be included to produce a triangular wave.



David Francis
Cannonvale, Qld. **$35**

Battery charger

A mechanical timer switch with a maximum timing period of 12 hours is used as the timing element in this cheap and simple charger for NiCad battery packs. Its SPST switching output is used to control a constant current source based around the MJE 2955 power transistor, Q1.

As the timer's contacts are normally closed and open only while the timer is running, a circuit was developed that works in reverse — charging while the contacts are open, and turning off when they are closed.

A number of diodes (D1 - D4) wired across the switch provide a voltage reference of 0.6 to 2.4 volts, depending on the number of diodes used in the circuit.

When the timer is running, the contacts open and the voltage drop across the diodes turns on Q1. Once the timer 'times out' its contacts close, bringing Q1's base-emitter voltage to zero. This turns off the transistor and consequently the charge current to the batteries.

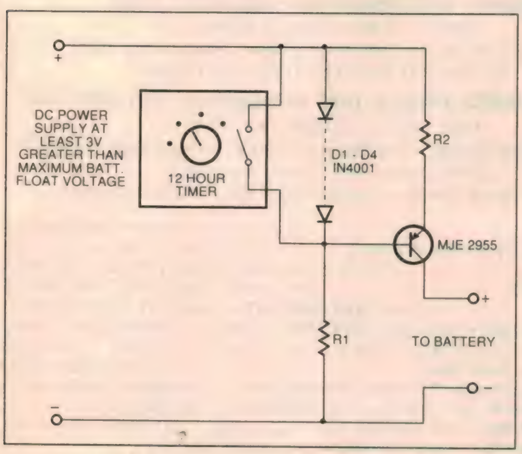
The battery charging current is approximately (Vref - 0.6)/R2, with R1 limiting the current through D1-4. A simple chart has been devised to determine the number of diodes, as well as the values of R1 and R2 for a wide range of battery charge currents.

For example, for a 1.2A-h Nicad battery pack which needs to be charged at 120mA for 11 hours, R1=1.36k, R2=14 ohms, and all four diodes would be needed.

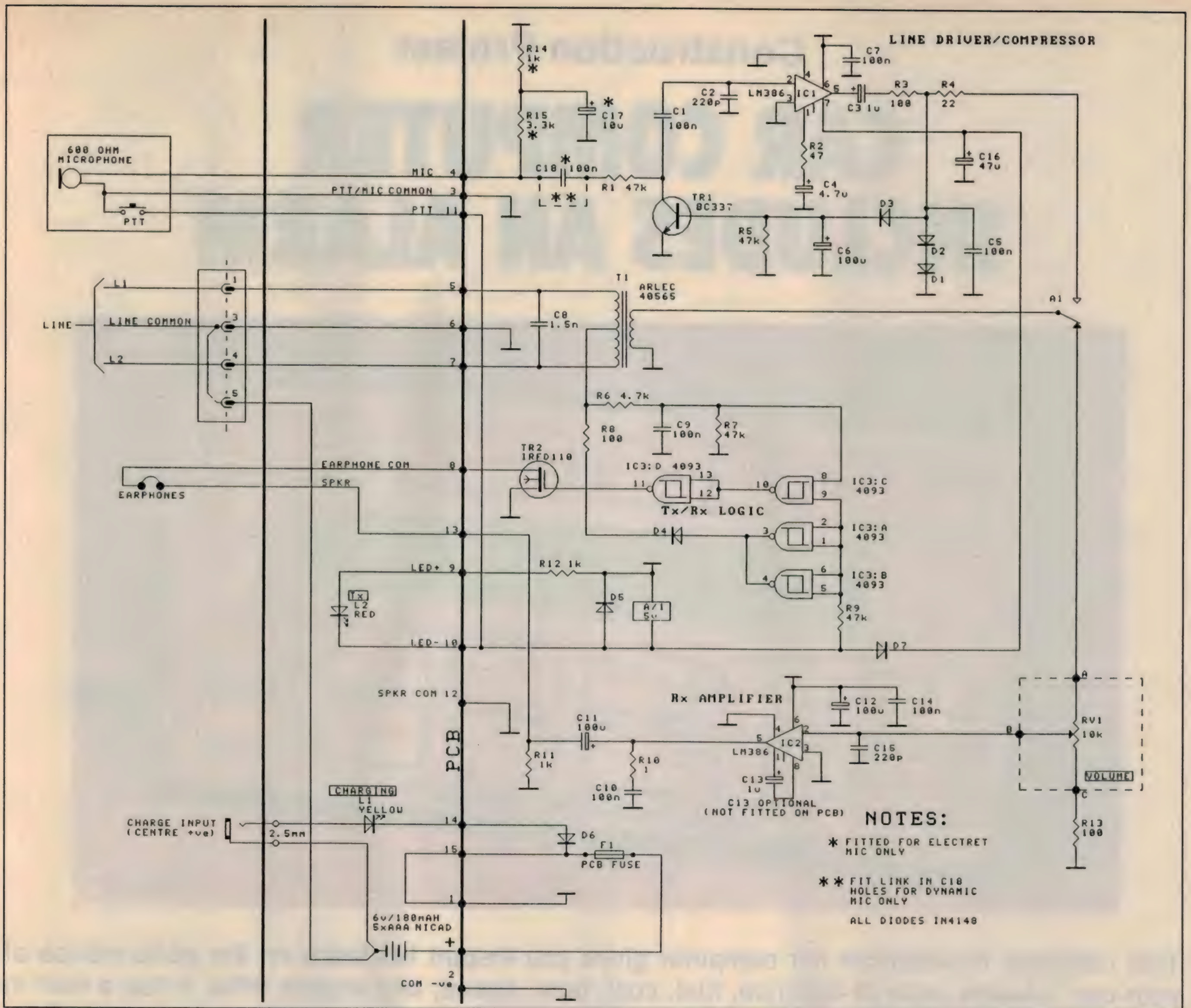
Note that these values are theoretical and the actual current should be checked with a meter before charging.

Branco Justic,
Oatley Electronics,
Oatley, NSW

(The mechanical timer switch as used in this circuit is available from Oatley Electronics for $8.00 plus postage. A complete kit of components for the charger is also available, for $15.00. Contact Oatley Electronics at PO Box 89, Oatley 2223, or phone (02) 9579 4985.)



R1	R2	CHARGING CURRENT 2 Diodes	3 Diodes	4 Diodes
340R	1.4R	430mA	860mA	1.3A
340R	1.8R	330mA	660mA	1A
680R	2.8R	210mA	430mA	640mA
680R	5.6R	107mA	214mA	321mA
680R	6.8R	88mA	180mA	270mA
680R	7.4R	80mA	160mA	240mA
1360R	8.4R	71mA	143mA	214mA
1360R	14.0R	43mA	86mA	129mA
1360R	22.4R	27mA	54mA	81mA



Three-line intercom

This circuit is used as a party line intercom by flag marshals at Wanneroo Race Track in WA. It uses standard two-pair cable, and at the present time there are 14 units on the circuit (2.5km of cable!). It includes a muting system, and draws around 5mA.

If no other unit is transmitting, the input to IC3c pin 8 is LOW. The other input is HIGH due to the path through relay A/1 and R9. This causes the output of IC3d to swing LOW. In this state TR2 is OFF and there is no return for the earphones to common negative.

If a station transmits, the input to IC3c pin 8 goes HIGH. This is because the transmitting station provides 6V to the line via the CT of the line transformer. R6 feeds the HIGH to pin 8 of IC3c, and this HIGH plus the HIGH on pin 9 of IC3c causes its output to go LOW and the output of IC3d to go HIGH. This turns on TR2, thus providing a return for the earphones and the transmission is heard.

The audio from the line is fed via relay contact A1 to the volume control and then to the audio amplifier IC2. If the PTT on the microphone is pressed, relay A/1 will pass transmit audio to the line via C3/R3/R4. IC1 is configured as a line driver/compressor with a dynamic range in excess of 35dB and the gain setting components R2/C4 were chosen to suit the microphone used.

D7 provides a mute signal to the line amplifier/compressor, which reduces the power consumption during receive by 50%. If the PTT switch is pressed, the HIGH on the inputs to IC3a, b, c (pins 1, 2, 5, 6 and 9) go LOW. This forces the outputs of IC3a and b to go HIGH. This is passed via D4/R8 to the CT of the line transformer, thence to the line and the other units.

Components R14/R15/C17/C18 provide for the use of an electret microphone as an alternative to the dynamic microphone shown. Power is supplied by an internal 180mA-h NiCad battery and a charging socket is provided. The negative return of the battery is connected through the line connector to the circuit, to get around the problems of on/off switches.

(Editor's Note: This circuit is designed for use on a private three-line system only. It cannot and will not work on the PSTN or other telephone systems, quite apart from legal considerations.)

Owen McConnel, VK6YBA
10 Loxham Place,
Greenwood, WA. 6024 **$40**

(A PCB for this circuit which is available as an Easytrax file from the EA BBS on (02) 353 0627, or by sending a disk and postage to the author, who will also answer any questions on the circuit .)

Construction Project

CAR COMPUTER INCLUDES AN ALARM

This compact, inexpensive car computer gives you instant feedback on the performance of your car. It keeps track of distance, fuel, cost, time, speed, and engine RPM. It has a built-in overspeed alarm, security alarm and standing sprint timer. So avoid those speeding fines, secure your car, improve your driving habits and save money (all at the same time) by building this versatile kit project.

by ROBERT PRIESTLEY

I originally became involved in designing a car computer for a rally car when some of my work colleagues entered a Kidney Foundation car bash and asked me to build a 'computer thingy' to help them navigate and to monitor the performance of their car. At the time I was experimenting with the Motorola 68705R3 microcontroller, and I figured that developing a car computer would be an excellent way to learn more about these devices.

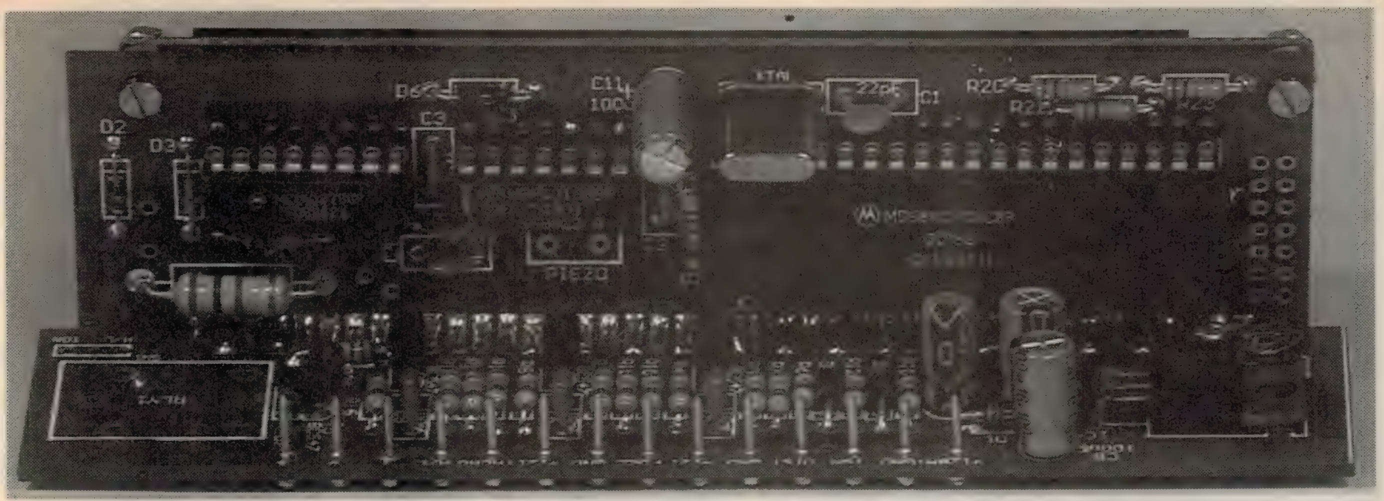
That was some time ago, and the car computer I developed then consisted of 10 multiplexed seven-segment displays, battery-backed RAM, and a keypad of 11 mechanical switches — all controlled by an R3 microcontroller, and housed in a standard instrument case. Not bad though, for my first microcontroller project!

But when I started developing the improved car computer presented here, I found I needed software development tools for the microcontroller. As these were both expensive and hard to get, I had to put the computer to one side while I developed a software package and programmer hardware board for the microcontroller. The resulting 68HC705 Development System which made this car computer possible was reviewed in the July '94 issue of *EA*.

So over the last five years my first car computer has undergone a major transformation into the low cost, compact unit described here. It has been tested in the most extreme conditions in both my car and in a 1966 Ford Falcon XP bash car, with outstanding performance. In fact this computer rivals commercially available units costing over $1500. Here's a summary of its main features...

Main features

The main features of the car computer include a custom designed four colour membrane keypad with acoustic feedback of each key press, and a specially designed black anodised case which gives a very rigid construction that is



Here's how the PCBs are soldered together. The display is mounted on the back of the processor PCB.

shock, dust and splash proof. The readout is a 24 characters x 2 line LCD backlit display that gives excellent day and night vision.

The computer gives a display of 18 parameters, covering distance, fuel, cost, time, speed and tacho readings in metric, imperial or US display formats on a high resolution display. There's a car alarm function via a custom PIN number, and a built-in battery backup option keeps data after the power is disconnected.

The sprint timer (resolution of 1/100s) can be used over any distance, typically for 400m/quarter mile timing. It also has a data logging option via a computer's serial port and special software, and it can be used as a rally computer (special software available).

The unit measures only 145 x 70 x 55mm, so mounting it in a car should not present any problems. All connections to the computer are made via a 12-way Utilux connector.

Operation

The car computer performs its calculations by measuring fuel flow, the distance the car has travelled and by counting engine revs per half second (converted to RPM).

Engine revs are sensed from the engine distributor. Fuel flow is measured with a fuel flow sensor and distance with a sensor which gives a known number of pulses for each revolution of a wheel on the vehicle.

All of these functions are continually updated by the computer, regardless of the function being displayed. To show these functions, the computer is initialised at the start of each journey. The CLEAR key is pressed to zero the distance counters, the amount of fuel used, the internal timers, and the peak speed/tacho display. You then enter the length of the journey to be taken. If this length is the same as the previous journey, it can be automatically loaded.

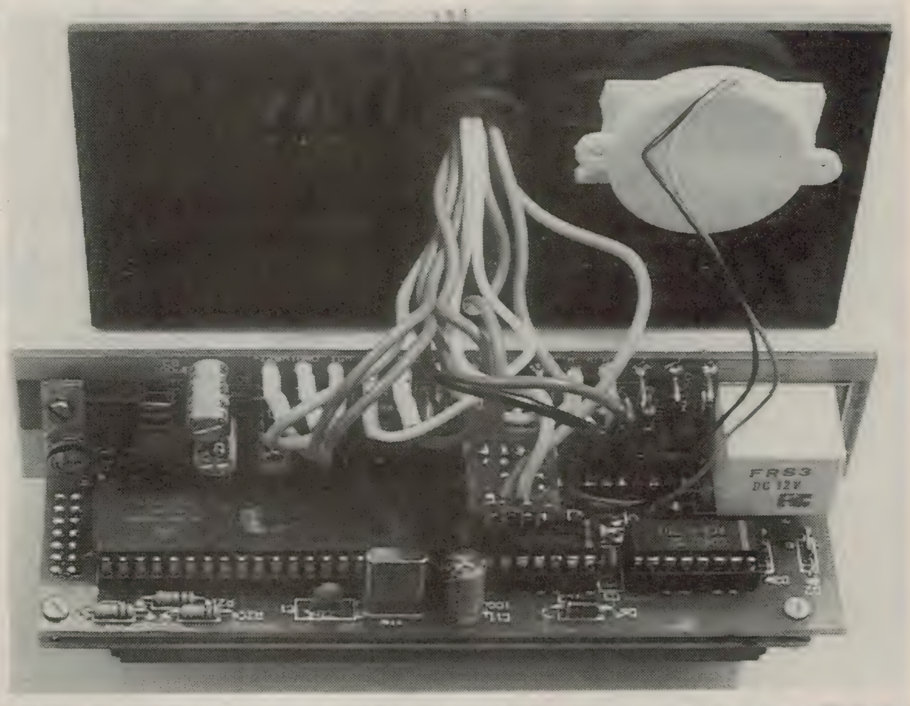
All distances are displayed with a resolution of 1/10km (or miles), and time calculations are displayed with a resolution down to seconds. Fuel calculations are displayed with a resolution of one tenth of a litre (or gallons).

A very useful feature of the car computer is the over-speed alarm. When driving, the SPEED ALARM key can be pressed, which causes the current speed to be stored in memory. If you exceed this speed by 5km/h an alarm will sound and the computer will automatically display your current speed.

The warning sound continues until your speed falls to less than 5km/h above the speed stored in memory, reminding you to slow down. This function can be disabled by pressing any of the display format keys.

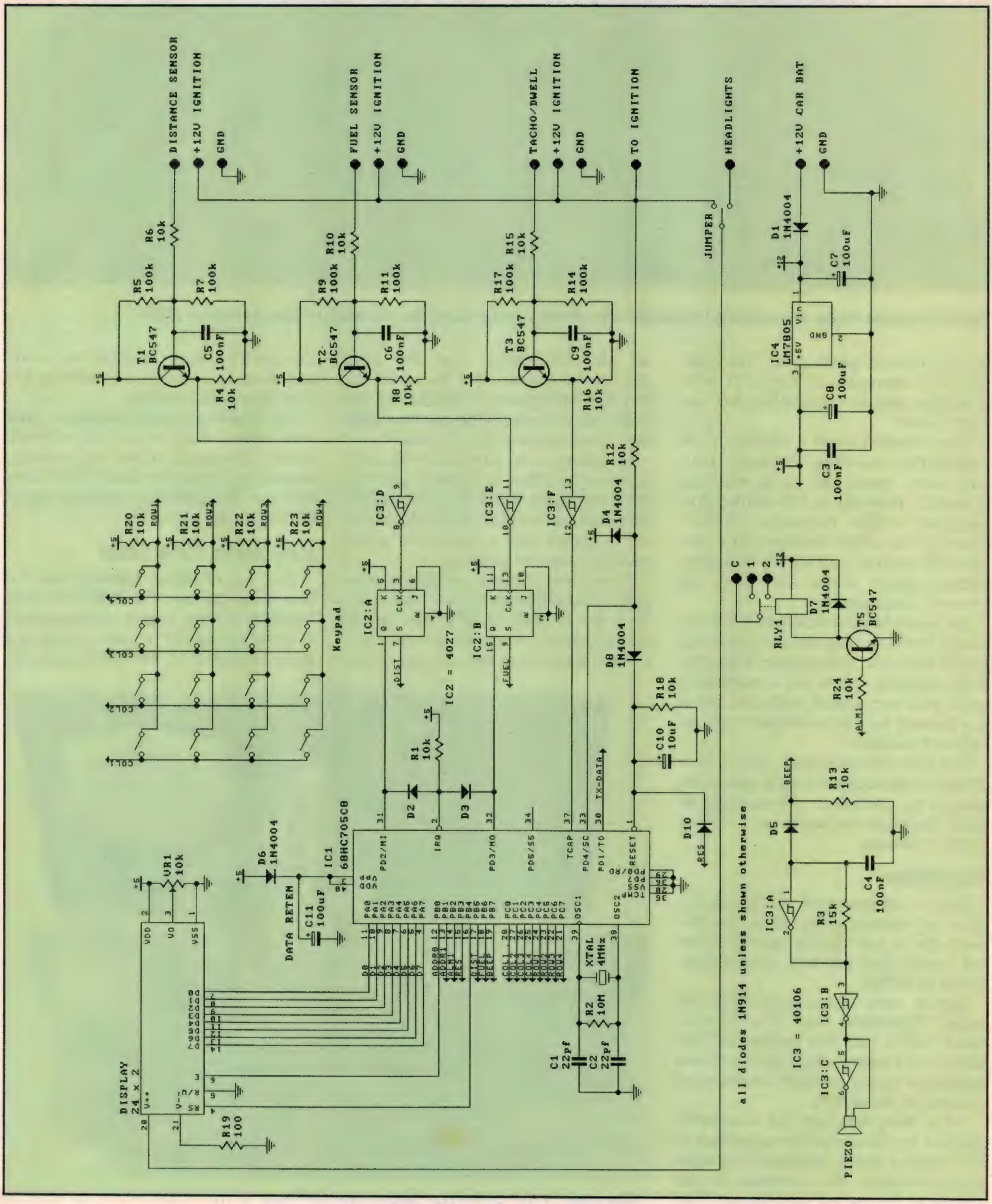
Keyboard functions

Each key of the car computer has two functions (except the ENTER key). Pressing any key selects a menu option. When the computer requires a numerical value to be entered, the number associat-



This shot of the prototype shows the unit fully constructed, ready to fit in the case. The small vertical PCB on the interface PCB (where the leads connect to) is only for testing purposes.

Car Computer Includes an Alarm



As most of the work is done by the microcontroller (IC1), the circuit is relatively simple. The input pulses from the sensors are buffered by T1-3 and fed to IC1. The keypad connects directly to IC1.

ed with each key is recognised. Otherwise its function is recognised. Naturally, all keys are labelled according to both their function and value. Here's a brief description of the main keys:

TIMER: This key is used to start and stop the computer's time. When the timer is stopped, the arrow (<) on the display will blink.

DISTANCE: This key toggles the display between the four distance parameters. These include total distance of the journey, distance remaining to the end of the journey, distance travelled on the odometer, and distance that can be travelled on the remaining fuel, based on the average fuel consumption.

FUEL: This key toggles the display between the eight fuel parameters. These include fuel used since start of journey, fuel remaining in tank, average and current fuel consumption expressed as litres/100km or km/litre, total fuel cost and journey fuel cost.

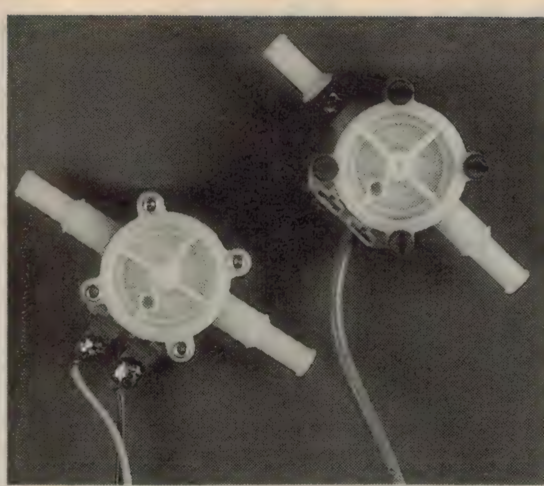
TIME: This key toggles the display between the three time parameters. These include elapsed time since start of journey, time remaining at average speed and current speed to complete the journey.

SPEED: This key toggles the display between the three speed parameters, which include current speed and tacho, average speed of journey, peak speed and tacho display.

ODOMETER: This key is used to display and clear the odometer counter. If the odometer counter is not displayed when this key is pressed, the display will switch to show the odometer reading. If the odometer is already displayed and this key is pressed, the odometer counter is cleared. A normal CLEAR does not affect this counter.

JOURNEY: The distance of a journey is entered with this key. If it's accidentally pressed, then either press the ENTER key or wait for the computer to time out and return to the main display.

FILL: This key is used to update the amount of fuel in the tank. It adds the entered value to the amount already in the tank. Once the quantity of fuel has been entered, the computer then asks you to enter the cost of the fuel. As with the JOURNEY key, if you accidentally press this key, you can either press the ENTER key or wait until the computer times out and returns to the main display.



These are typical fuel flow sensors that can be used with the car computer.

Calibrate options

The CAL key allows you to calibrate, configure and test the computer. When this key is pressed a scrolling menu is displayed, giving a number of options. The first of these is the Calibrate Tacho option, as the tacho needs to be calibrated for the number of cylinders in the engine. Enter the number of cylinders by pressing one of the keys marked 4, 6 or 8.

The Calibrate Distance Sensor option offers two ways to calibrate the distance sensor. The most accurate way is to travel a known distance while the computer counts the number of pulses received from the distance sensor. You then enter the distance travelled into the computer, so it can calculate how far the car travels for each pulse received from the distance sensor.

The second method is to first calculate the diameter of the wheel fitted with the distance sensor, and to divide this value by the number of pulses produced per revolution. This number is then entered as a calibration value into the View/Modify Distance Sensor Calibration option. This number should be in millimetres for every pulse received from the speed sensor. The first method is probably the easiest, but the second method lets you fine tune the calibration.

This photo shows the recommended distance sensor. It is only needed for cars that have a mechanical speedo.

The Calibrate Fuel Sensor option requires you to enter a calibration value for the number of pulses per 0.1 litres of fuel used. The computer uses this value to calculate how much fuel is represented by one pulse from the fuel sensor, and stores this as a fuel calibration factor.

A useful option when installing the computer is the View Sensor Pulses. This option lets you view the distance, fuel and tacho inputs to confirm the sensors are working. The number of pulses can be cleared by pressing the CLEAR key at any time.

The Standing Sprint Timer option is used to time the car over any distance, with a resolution of 1/100 seconds. Before entering the sprint timer mode, enter the distance of the sprint using the JOURNEY key. Typically this would be 400m (1/4 mile). Once selected, an eight second countdown begins — then it's 'pedal to the metal'. Of course, you'll only be using this facility at an appropriate venue!

Security: This option is used to enable/disable the alarm. To enable the alarm enter a four-digit PIN number, to disable it enter zero. Once this function is enabled, every time the ignition is switched on the computer will prompt you for a PIN number. The relay (if fitted) will remain off until the correct number is entered.

Three incorrectly entered PIN numbers locks the computer out, so be careful. The relay contacts can be connected to an existing car alarm, to a solenoid valve in the fuel line, or so the engine is disabled while the relay is de-energised.

Other keys

The CLEAR key is used to zero the distance travelled, fuel used, peak speed/tacho and timer values. As a precaution, this key must be pressed twice. Once cleared, the 'distance travelled' is loaded into the 'distance remainder' of the journey.

This is useful if you are regularly driving the same distance, for example to and from work. By clearing the computer at the beginning of each trip, the dis-

Car Computer Includes an Alarm

PARTS LIST

Resistors

All 1/4W unless shown otherwise:

R1,4,6,8,10,12,13,15,16,18,20-24	10k
R2	10M
R3	15k
R5,7,9,11,14,17	100k
R19	100 ohm 1W
VR1	10k PCB mount

Capacitors

C1,2	22pF ceramic
C3-6,9	0.1uF monolithic
C7,8,11	100uF electrolytic
C10	10uF electrolytic

Semiconductors

D1,4,6-8	1N4004 diode
D2,3,5,9	1N914 diode
IC1	preprogrammed 8HC705C8
IC2	4027 dual JK flipflop
IC3	40106 hex Schmitt inverter
IC4	LM7805 3-terminal regulator
T1,2,3,5	BC547 NPN transistor
Xtal	4MHz crystal
Display	24 char x 2 line LCD

Miscellaneous

Two double-sided PCBs; 16-key membrane keypad; piezo buzzer; 12V relay; case; leads; 12-way Utilux connector; sensors (as needed).

A kit of parts for this project is available from Oztechnics, PO Box 38, Illawong, 2234; phone (02) 541 0310, fax (02) 541 0734, e-mail oztec@ozemail.com.au.

Car computer kit (PCB, components, case)	$265
Fuel flow sensor	$85
Speed sensor	$30
Alarm relay	$5
12 way Utilux connector	$5
Packing & Postage	$10

These prices were correct at time of publication.

This project remains copyright to Oztechnics Pty Ltd.

tance remaining to the end of the journey will be initialised. From this, the computer can calculate the estimated time of arrival etc.

Individual parameters can be cleared by pressing the CLEAR key and then keys 3 (clears the fuel in the tank), 4 (clears the timer) or 5 (clears the total fuel cost).

Pressing the DISPLAY key moves an arrow to point to the line on the display that will be changed when one of the four display parameter keys is pressed. The DISPLAY key is therefore used to toggle the arrow between the top and bottom rows of the display. This key doubles as a decimal point key.

The ENTER key is used to store values in the computer, and is the only key with one function.

The METRIC DISPLAY/TRIP-1 key sets the display to metric format (kilometres and litres), which is the default. It's also used to zero the trip-1 counter in the optional rally computer.

The IMPERIAL DISPLAY/TRIP-2 key sets the display to imperial format (miles and gallons) and doubles as a means of zeroing the trip-2 counter in the rally computer.

The US DISPLAY/HOLD key sets the display to US format (miles and US gallons). To distinguish between US and imperial gallons, the US format shows gallons in capitals. This key is also used to stop the distance counters in the rally computer.

The SPEED ALARM/RALLY key sets the overspeed alarm already described. Pressing any of the DISPLAY keys just described cancels the overspeed alarm. This key is also used to toggle between the car computer and rally computer operating modes. This function is not available with the standard software, as it requires a C9 microcontroller (16K EPROM).

Circuit diagram

The heart of the circuit is a Motorola 68HC705C8 microcontroller (uC), which is supplied already programmed. The display is operated directly by the uC, and you have the option of connecting the backlighting of the display to either the incoming 12V from the ignition switch (backlighting is therefore always on) or to the vehicle's headlights. The latter option means the backlighting will be on only when the headlights are on. A jumper on the PCB selects the required option.

The keypad also connects directly to the uC, via the COL and ROW terminals. The three incoming signals are buffered by emitter follower stages (around T1, T2 and T3), then shaped and inverted by the Schmitt trigger inverters of IC3d, e and f.

The distance and fuel pulses are interfaced to the uC via JK flipflops (IC2) to give, in effect, an extra interrupt line. Serial data is available at pin 30 (TX-DATA) of the uC.

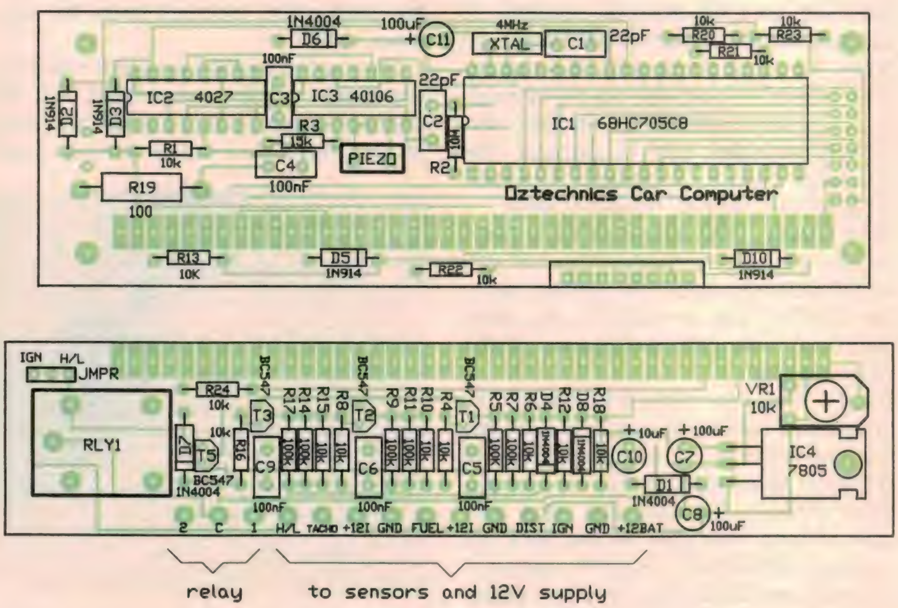
A reset signal is applied to the uC via the +12V supply from the ignition switch. This supply is available at three points on the PCB for connection to the various sensors. Diode D4 clamps the 12V input to the required 5V for application to the uC.

The piezo buzzer is operated by the oscillator around IC3a, which is pulsed on by the BEEP signal from the uC. The alarm relay is driven by T5. A regulated 5V supply is provided by IC4, and filtered by C3, C7 and C8.

Construction

Construction of the car computer is quite simple. More details, including the sequence of mounting the components, are given in the manual supplied with the kit.

All the circuitry is contained on two



This layout shows the component placement for both PCBs. The manual with the kit gives complete assembly instructions.

small double sided, plated-through component masked PCBs, which are soldered together at right angles.

The liquid crystal display mounts on the back of the processor PCB, held in place with four metal thread screws and nuts. The display is spaced about 3mm from the processor PCB. Connections between the display and the PCB are made with 14 links.

The membrane keypad is fixed to the clear perspex front of the case using its own self-adhesive back. The keypad is then connected to the PCB via a special membrane keypad ZIF connector. The completed PCB assembly slides into the aluminium case and the front and rear perspex panels are then snapped into place.

Use PCB pins for connecting the wiring harness to the computer. I recommend using heatshrink sleeving over each soldered connection for increased reliability. This wiring connects to a 12-pin Utilux connector.

Installation

The power requirements for the computer are two +12V DC supply lines, one that is *not* switched by the ignition, and another that is. A ground line is also needed. There are no fuses in the computer, so the supply lines should be individually fused.

The tacho function needs a cable from the ground side of the distributor back to the computer. Or, if there's a tachometer in the vehicle, connect the computer tacho function to the vehicle's tachometer. Most cars these days have a pre-wired harness with these cables already provided.

A distance sensor might not need to be installed, depending on the vintage of the car. Most new cars have an electronic speedo and a sensor already fitted, which can be used with this computer. If not, you will need to install a distance sensor.

The most accurate way is to mount the sensor on a non-drive wheel, to avoid errors caused by wheel slip. The sensors supplied by Oztechnics have been selected especially for this application.

To install the fuel flow sensor, you need to break into the fuel line carrying the fuel actually flowing into the *engine*, which is not necessarily the line from the fuel tank. This is because most modern cars use a recirculating fuel system, in which unused petrol is pumped back to the fuel tank.

In a recirculating system, there's usually a fuel line that goes back to the tank, and another that supplies fuel from the tank, both connected to a tee-piece at a point before the carburettor. The sensor is fitted into the line that runs from this tee-piece to the carburettor. The exact arrangement will depend on the make of the car.

When installing the fuel flow sensor, make sure the arrow on the side of the sensor points in the direction of fuel flow. Because of its light weight, the sensor can be mounted so it's suspended by the fuel line. That is, it won't need supporting brackets. Avoid mounting it close to any ignition leads and keep it well away from the exhaust manifold to avoid heat damage and the possibility of vapour lockup.

The fuel flow sensor is not suitable for fuel injected engines. However I have been investigating developing software so the car computer can measure the pulse width at the fuel injectors and calculate the fuel consumption from this information. (There might be a special EFI version ready by the time this project is published.)

Rally computer option

A special rally computer version is available that uses a C9 microcontroller. This controller has a 16K EPROM, which is needed for the increased number of features. One of these features is a facility for connecting a PC to the rally car computer (via its serial port) for data logging. The rally car computer constantly sends information, which for example can be sent via a modem and mobile phone.

A suitably equipped PC, with a special software package, can then be used to monitor the performance of the car. ❖

ABOUT THIS PROJECT

This article presents one of the most compact and well presented designs for a car computer we have seen. The project is only available as a kit (see end of parts list), and each kit includes a manual giving instructions for assembling, installing and operating the computer. In this article the designer of the project therefore doesn't cover every aspect of its installation and operation. However, after reading it, we think you'll be as impressed with the car computer as we are.

Construction project:

PC-DRIVEN AUDIO SWEEP ANALYSER - 1

As promised, here's the design for a PC-controlled audio signal and sweep analyser, based on the low cost DDS frequency synthesiser and ADC modules described in the September issue. With a frequency resolution of 0.25Hz and an overall response flat within 0.1dB between 15Hz and 35kHz, it's very suitable for professional-level testing and analysis of amplifiers, filters, preamps and other audio circuitry.

by TIBOR BECE and JIM ROWE

First of all, a brief explanation regarding the dual bylines on this article. Like the RF Sweep Analyser described in the October issue, this project is based on the low cost DDS (direct digital synthesis) generator module and ADC (analog to digital converter) modules designed by Tibor Bece, which were presented in the September issue. Tibor also wrote the matching PC software drivers and sweeping program.

In this case much of the rest of the circuitry is also based on design work by Tibor, although Jim Rowe contributed some of the supplementary design, and designed the PCBs for the 'front panel' board and the power supply module (described separately). As with the previous articles this one is also being written by JR, but because of the greater role played by TB a joint attribution seems appropriate.

Now to the new analyser itself. As already mentioned it's based on Tibor's DDS and ADC modules, with the DDS module forming the heart of the 'generator' section and the ADC module forming the digitiser for the 'analyser' section. Note, though, that neither module is used in exactly the same form it took with the RF instrument.

The L-C low pass filter previously used to clean up the output of the DDS module is now omitted, and replaced with a more suitable active R-C filter. Also the original on-board 50MHz crystal clock oscillator is now replaced with a small crystal oscillator 'daughter board', providing a clock frequency of 4.194304MHz to give the desired frequency resolution.

Similarly the original log detector section of the ADC module is now not used. The signal detecting function is now performed instead by a more appropriate low noise precision active linear rectifier circuit, preceded by a high impedance input buffer and attenuator, and followed by a low pass filter.

By the way, because of these changes Tibor will now be supplying *two* versions of the kits for each module: an 'RF' version and an 'audio' version. So make sure that you clarify which versions you want, when you're ordering them.

The audio version of the DDS module will include the additional parts for the 4.194304MHz clock oscillator in place of the 50MHz oscillator module, and also the resistor and capacitor for the first stage of the audio LP filter, in place of the LC filter components. Similarly the audio version of the ADC module will have the MC3356 log detector chip and its reg-

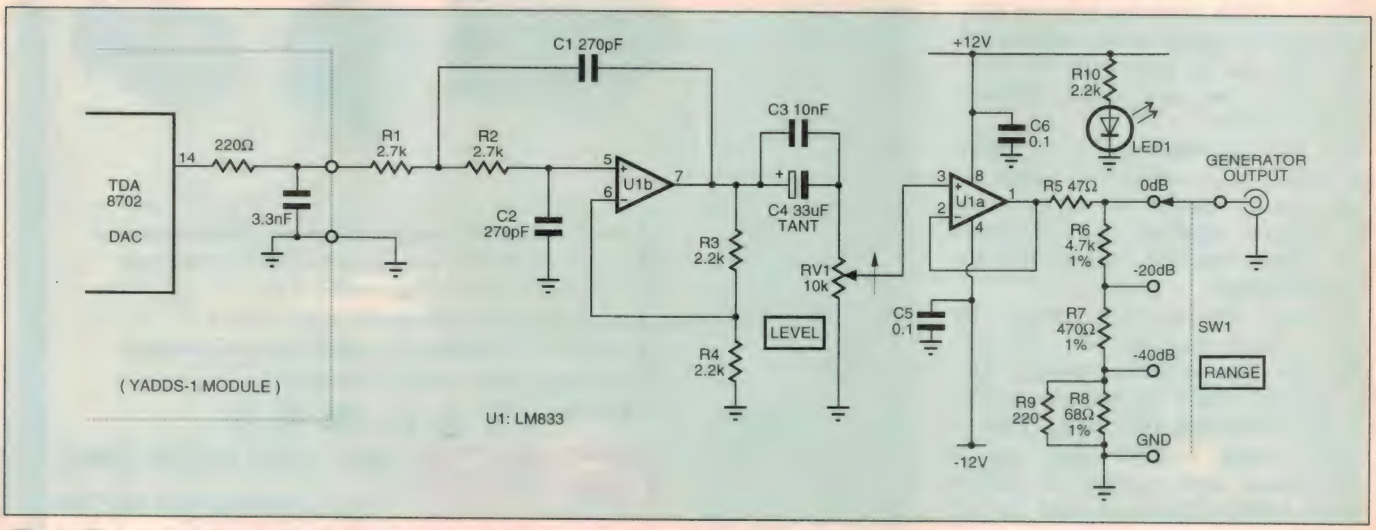


Fig.1: The generator output circuitry used in the new audio sweep analyser. U1b forms a low pass filter, which along with the two components in the YADDS-1 module replaces the L-C filter used in the RF sweeper.

ulator U4 omitted, along with their associated components.

Before we look at the new design in detail, though, a bit more about its performance. As with the RF analyser the 'generator' section can operate as either a programmable-frequency signal generator or a sweeping generator, while the wideband detector/analyser section can operate as either an independent digital audio level meter or a detector for sweep analysis. Both are simply and elegantly controlled by the PC via a standard Centronics parallel interface, under the control of software specially written by Tibor. The nett result is an audio generator/level meter/sweep analyser with a very impressive level of performance.

The generator section will produce any desired frequency between 0.25Hz and 120kHz or more, with crystal accuracy and a resolution of 0.25Hz. A combination of a three-step fixed attenuator and a variable level control allows its output level to be easily adjusted (manually) over a wide range, from over 1V RMS down to well below 1mV — i.e., over a range of significantly more than 60dB. And once set to the desired level, its output level remains flat within 0.1dB between 5Hz and 40kHz; in fact it's typically only 0.5dB down at 1.5Hz and 100kHz.

The generator's output impedance is lower than 500Ω on all settings of the output attenuator, which also provides a 'GND' setting for instant disabling of the output. The output signal is clean over most of the audio spectrum, and relatively low in distortion — less than 0.5% THD over the full range.

Most of the distortion present is due to the limitations of the low cost 8-bit video DAC used in the DDS module. The main effect is due to its limited

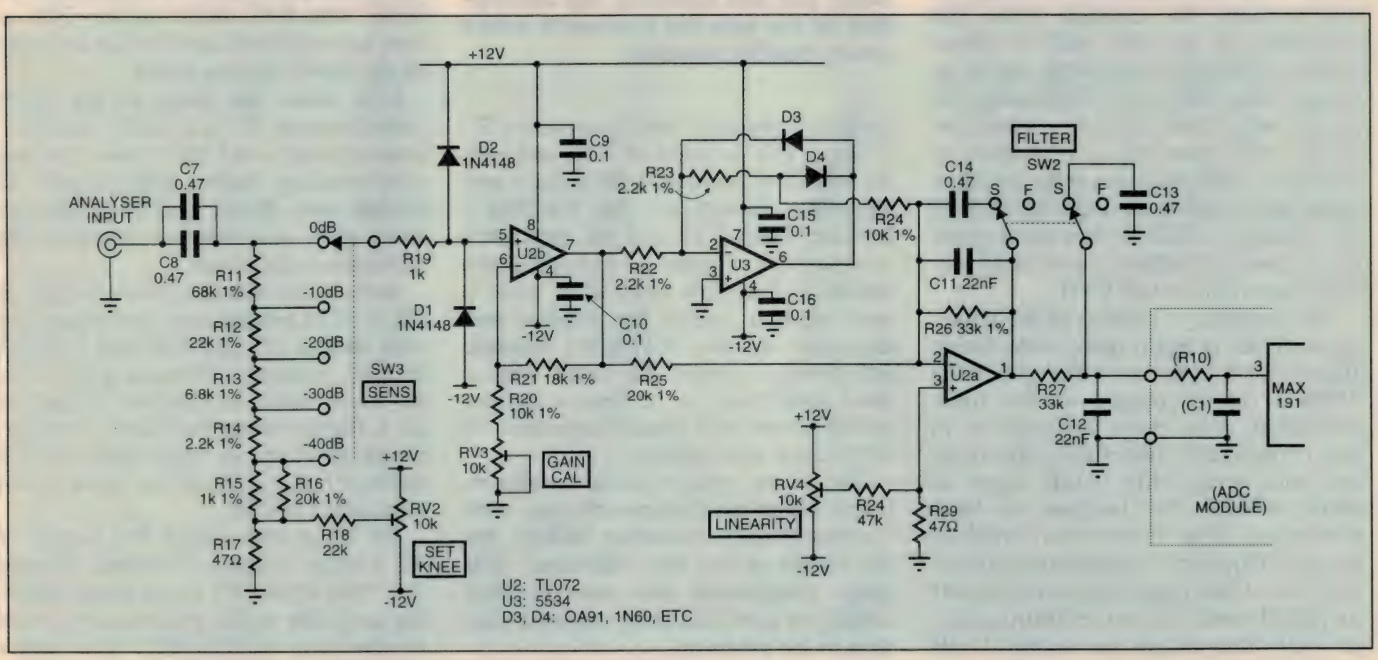


Fig.2: The 'front end' circuitry for the analyser section of the instrument. U3 is an active half-wave rectifier, and the combination of this stage with U2a forms an active fullwave rectifier. U2a also functions as an active filter.

amplitude resolution, which produces in particular tiny (i.e., just discernable) 'flats' at the positive and negative waveform peaks, corresponding to predominantly odd-harmonic distortion. However over most of the range the third harmonic (the worst) is at least 47dB down from the fundamental, while the fifth is 55dB down or better. The even harmonics and spurious components are generally below 60dB down.

The detector/analyser section has an input impedance of 100kΩ, which should be more than sufficient to prevent loading in the majority of audio circuits. It has a nominal input sensitivity of 1V RMS, and is provided with an input attenuator giving four 10dB steps — reducing the sensitivity to 100V RMS on the lowest (-40dB) range.

In theory the analyser's 12-bit ADC gives a maximum potential dynamic measurement range of 72dB. However like most active precision rectifiers, the one used here has a more limited linearity range. This limits the effective dynamic measurement range to about 46dB, or about 200:1 — still plenty for the vast majority of audio measurements, especially when you consider that it applies to *any* of the five input attenuator ranges.

By the way, despite this limiting effect of rectifier linearity the 12-bit ADC still provides a major advantage in terms of measurement resolution, when compared with an 8-bit ADC. The additional four bits translate to 24dB of improvement; for example while the resolution of an 8-bit ADC is about 0.4% or 0.035dB steps at the top of its range, it has fallen to 0.35dB steps for signals only 20dB down. In contrast our 12-bit ADC provides a resolution of 0.025% or 0.002dB steps at the top of its range and is still resolving 0.02dB steps for signals at -20dB; it does not degrade to the same 0.35dB/step level until signals drop to the -44dB level.

The frequency response of the detector/analyser is again quite wide, being flat within 0.1dB from 10Hz to beyond 100kHz on all ranges of the input attenuator. The basic analyser is in fact considerably better than this at the top end, being only 0.1dB down at about 400kHz; but because we have elected not to go to the extra complexity of a frequency-compensated attenuator, the -10dB range begins rolling off at 100kHz and this is the limiting factor. All other ranges are within 0.1dB to 400kHz.

The nett result, then, is that both the generator and analyser sections, and also the combination of the two, are essentially flat within 0.1dB between 15Hz and 35kHz — making them capable of performing accurate, high resolution measurements on a wide range of audio circuitry and components.

Circuit details

The generator section output circuitry is shown in Fig.1. As you can see, it's quite straightforward and based on an LM833 dual low noise op-amp.

As mentioned earlier, the L-C low pass filter used to 'clean up' the output of the RF version of the YADDS-1 module is replaced here by an active R-C filter. This is based on U1b, and uses R1-R4, C1-C2 and also the resistor and capacitor shown on the YADDS-1 module itself. U1b and its associated components forms a second-order Sallen & Key low pass filter, with a gain of two, while the resistor and capacitor on the YADDS-1 module effectively convert the filter into a third-order type, to achieve a steeper rolloff slope and greater rejection of DDS clock components.

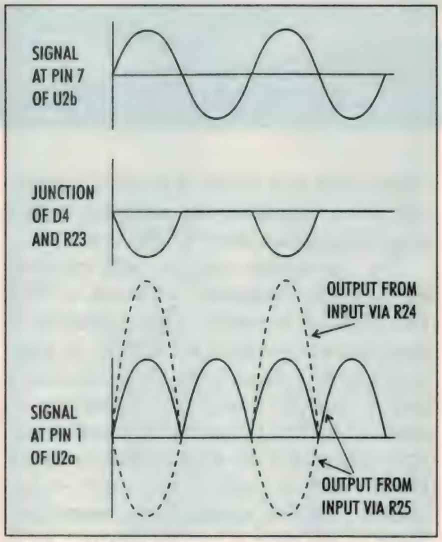


Fig.3: Use this diagram as a guide when you are following the description of the way the analyser's active linear rectifier operates.

The filter characteristic conforms nominally to the Butterworth type, with a corner frequency at about 160kHz, but the values of the two additional 'first stage' components have been tweaked slightly to give maximum response flatness in the passband.

From the output of U1b, the signal is fed through coupling capacitors C3 and C4 to pot RV1, which serves as the 'fine' output level control. It then passes to U1a, which serves as a unity gain output buffer. U1a in turn drives the output attenuator, via protective resistor R5.

The output attenuator is a simple voltage divider type using R6-R9, and providing steps of -20dB and -40dB in addition to the 'straight through' 0dB position and the 'GND' or zero output position. The divider values and buffer stage ensure that the output impedance remains below 500Ω on all ranges, which should be fine for most audio work.

LED1 serves as a 'pilot light' for the analyser, with R10 limiting its current to about 5mA.

The 'front end' circuitry of the analyser section is shown in Fig.2. This may look a little more complicated, but is logically divided into four basic sections: the input attenuator, the buffer/preamp, the precision rectifier and the output filter.

Resistors R11-16 form the divider-type input attenuator, with capacitors C7 and C8 blocking any DC component that may be present at the input. The resistor values are chosen to give four quite accurate 10dB division steps, in addition to the 'straight through' or 0dB top position.

Resistors R17, R18 and preset pot RV2 are used to inject a small DC offset voltage into the bottom of the divider, adjustable in terms of both amplitude and polarity, to set the exact operating point of the diodes in the precision rectifier. Because R17 is effectively in series with R15, shunt resistor R16 is used to compensate and restore accuracy on the lowest divider range.

U2b forms the heart of the input buffer/preamp. U2 is a TL072 dual FET input op-amp, and U2b is connected as a non-inverting buffer with a gain of around two. Preset pot RV3 sets the exact gain, and therefore becomes the calibration adjustment.

At the heart of the precision rectifier is U3, a 5534 fast op-amp, in conjunction with diodes D3 and D4, and resistors R22-25 inclusive. Without going into too much detail, U3 and the diodes act as a highly linear half-wave rectifier, which produces an output only for the *positive* half-cycles of the input signal from pin 7 of U2b.

For these half-cycles, the output of U3 swings negative, forward biasing D4. This allows U3 to act as an inverting amplifier with a gain of unity, as set by the ratio of R23/R22. The output signal appearing at the junction of D4 and R23 is therefore an inverted ver-

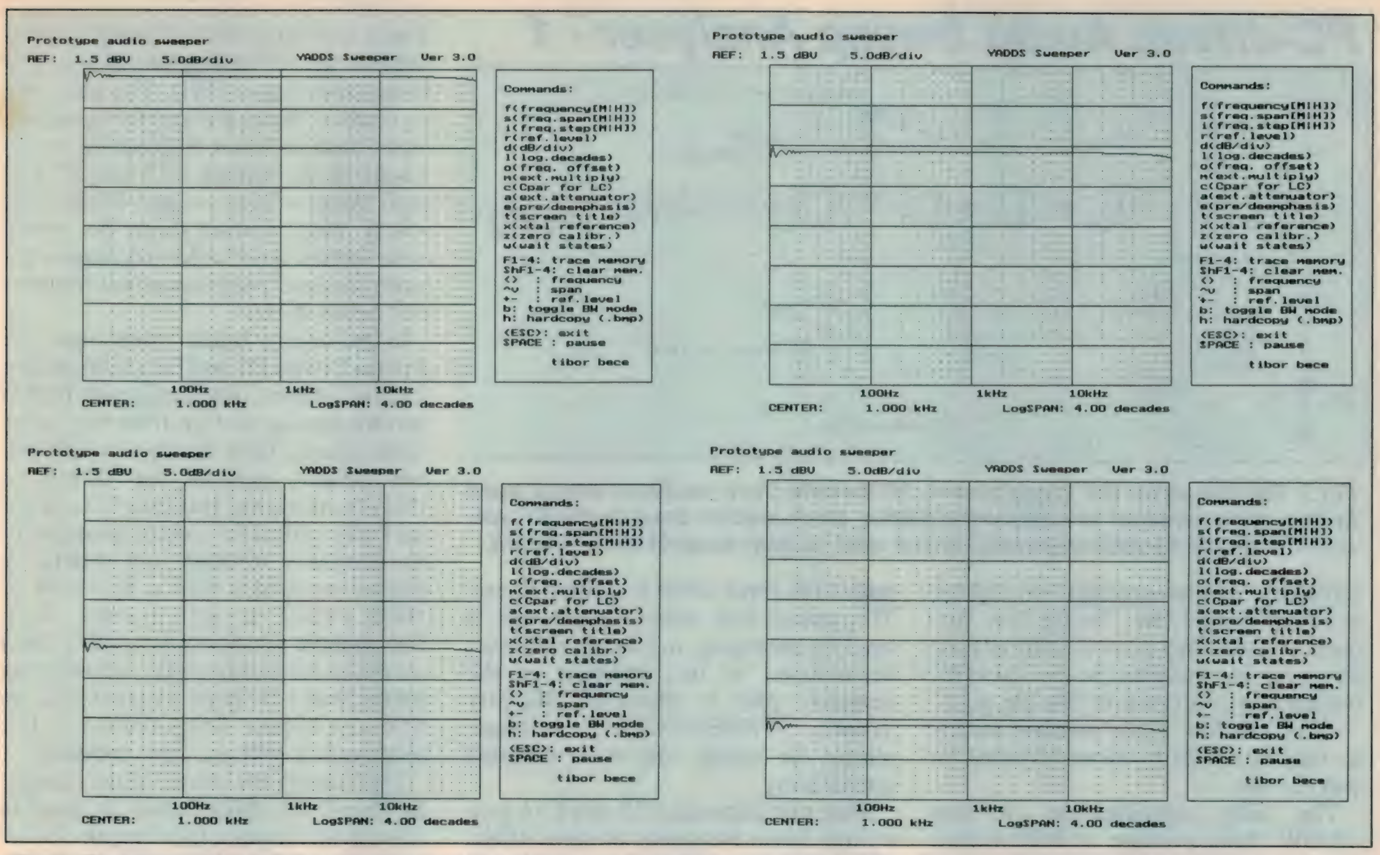


Fig.4: Four examples of the screen dumps which can be produced using Tibor Bece's SWEEPER.EXE software, somewhat smaller than actual size. As it happens, they also illustrate the overall response of the complete audio sweeper. As you can see, it's flat within 0.1dB between 15Hz and 35kHz, making it very suitable for most audio testing.

sion of the signal at pin 7 of U2b, for *these* half-cycles.

For the alternate half-cycles, though, where the signal at pin 7 of U2b swings negative, the stage behaves quite differently. Because the output of U3 now swings positive, diode D4 now becomes reverse biased, and disconnects R24 from the op-amp's output. Instead D3 is forward biased, connecting the op-amp output directly back to the inverting input. Both inputs of the op-amp are therefore held at ground potential, and the junction of D4 and R23 therefore remains effectively 'locked' at ground for the duration of these half-cycles.

But what is the function of resistors R24 and R25? That's a good question, because it is these — in conjunction with U2a — which turn the circuit into a full-wave rectifier.

Note that R25 provides a signal 'bypass' path around the U3 stage, feeding to the inverting input of U2a in parallel with R24. But as you can see, the value of R25 is also exactly twice that of R24. So U2a, as well as performing the function of a low-pass filter (as we'll see shortly) also functions as a *summing amplifier* — producing an output which is determined both by the signal fed to it via R25, as well as that fed via R24.

What happens is this. During the complete signal cycle, R25 feeds the signal direct from pin 7 of U2b; for this signal, U2a has an inverting gain equal to the ratio R26/R25, or -1.65. (The minus sign indicates inversion.)

Now during the negative signal half-cycles, U3 produces no output, as we have seen. So for these half-cycles there is no additional signal contributed to U2a via R24. But during the positive half-cycles, U3 operates as a unity gain inverter. So for *these* half-cycles, there's an additional and already inverted signal fed to U2a via R24.

The gain of U2a for this second signal is R26/R24, or +3.3. Note that because R24 has a value of exactly half that of R25, the gain for this signal is exactly TWICE that for the signal arriving via R25 — and that because it is already inverted, any output from it will swing back to the original polarity.

So during the negative half cycles, the output of U2a is an inverted version of the input signal, with -1.65 times its amplitude. But during the positive half cycles, it becomes the *sum* of -1.65 times the input and +3.3 times the input — and if you add these two together, you find that it gives +1.65 times the input. In other words, the signal coming via U3 and R24 completely 'overpowers' the direct signal via R25, swinging the output of U2a positive for these half-cycles as well.

The nett result is that the output of U2a becomes an accurate full-wave rectified version of the input signal, with both half-cycles converted to positive excursions and having an amplitude 1.65 times the signal at pin 7 of U2b. Fig.3 should help to make this clearer.

Of course like all rectifiers, this one tends to produce unidirectional pulses rather than steady DC. Therefore as we want to end up with a steady DC version of the signal, for feeding the ADC, we need to perform filtering. This is the second function of U2a, in conjunction with C11, C14, R7, C12 and C13.

In the 'fast' position of filter switch SW2, C11 is connected in parallel with R26. This lowers the gain of U2a at higher frequencies, turning it into an 'integrator' or low-pass filter as well as a summing amp. Then R7 and C12 provide a second stage of low-pass filtering, so that for most input frequencies, the signal fed to the MAX191 ADC chip is a smooth DC voltage, with an amplitude proportional to the incoming AC signal.

This level of filtering is fine for signals above about 50Hz, but is still not

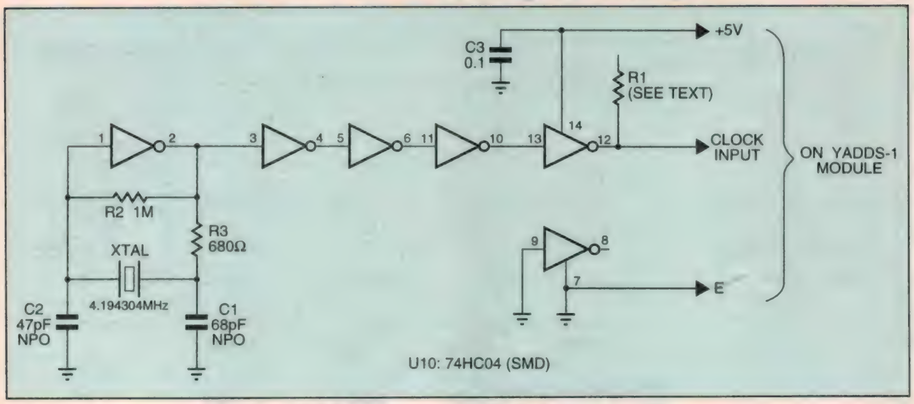


Fig.5: The circuit for the 'piggyback' 4.194304MHz clock oscillator board, used in this audio sweeper to replace the 50MHz clock module used in the RF version. R1 is used purely to provide a wire lead, to help support the PC board.

sufficient for measurements on signals at lower frequencies. So for low frequency work, SW2 allows additional filtering to be provided in the 'SLOW' position, by switching in 'the big guns' — C13 and C14. These increase the filter time-constants by about 20 times, as you can see.

The only complication in this 'SLOW' filter position of SW2 is that the longer filter time-constants necessarily require a longer time before the output DC level settles to its final figure. This means that when the analyser is used for sweeping, the sweep rate must be reduced in this position or the response plot is distorted. Happily Tibor's SWEEPER.EXE software allows the sweep rate to be adjusted quite easily.

Note that although C13 and C14 give a filter corner frequency of about 10Hz, this is still not sufficient to remove all ripple for very low input frequencies. That's why you can see small undulations in the response plots of Fig.4, at frequencies below 20Hz. The only way to remove these (or strictly speaking, move them to lower frequencies again) would be to increase C13 and C14 to even larger values — say 4.7uF. This would mean slowing down the sweep even further, but it's the only way to get more accurate measurements at frequencies below 20Hz.

In passing, a quick word about the diodes. Diodes D1 and D2 are protective 'catcher' diodes, used along with R19 to prevent damage to U2b from very large input signals. They can be low cost silicon diodes such as the 1N914 or 1N4148, as shown. However D3 and D4 are fairly critical for correct operation of the precision rectifier, and should be germanium diodes such as the OA91 or 1N60 (which is still a stock line). Failing these you could use a 5082-2800 or similar hot carrier diode, although the results won't be quite as good. But do NOT use silicon diodes for D3 or D4, because they will not work correctly!

Fig.5 shows the circuit of the 'daughter board' oscillator which is used to provide the master clock signals for the audio version of the YADDS-1 module, in place of the 50MHz oscillator used in the RF version. As you can see, it uses a 74HC04 hex inverter, with one inverter used as the crystal oscillator and four of the others for buffering. The crystal used is a 4.194304MHz type, with this frequency chosen because it is an exact binary multiple and results in a DDS frequency resolution of exactly 0.25Hz.

Incidentally while it is possible to use crystals of other frequencies (say 4.000MHz or even 3.58MHz), because Tibor's software can be configured for virtually any DDS reference frequency, the generator performance with these would very likely not be quite as good — either in terms of frequency accuracy or spurious output levels.

What's the purpose of R1, connected only to pin 12 of the 74HC04? Clearly this resistor is not needed electrically; it is used purely because the lead connected to pin 12 provides the 'clock' signal connection between the daughter board and the main YADDS-1 board. In the same way, the leads of bypass capacitor C3 are left long, and used for the +5V and ground connections. As the daughter board is very small and light, it's actually supported by the three connection wires.

Next month, we'll look at the construction and setting-up of the new Audio Sweep Analyser.

(To be continued.) ❖

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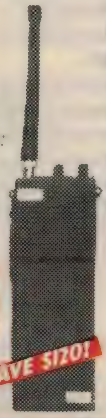

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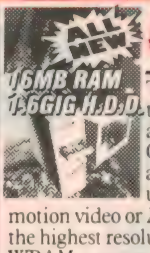

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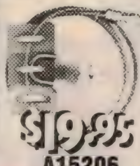

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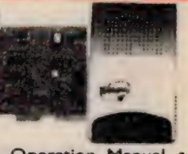

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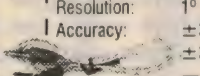

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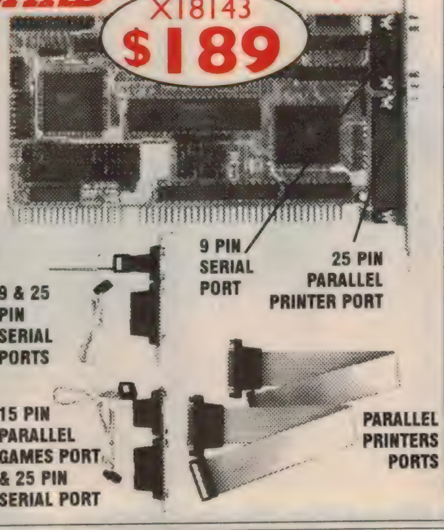

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Construction project:

SUBWOOFER/BRIDGE ADAPTOR FOR 12V

If you need an active subwoofer filter or amplifier bridging adaptor, but only have a 12V DC power source available — as is the case with car sound systems — this inexpensive adaptor box should be just the shot. It can be configured to perform either of these tasks, accepts input signals at either speaker or line levels and has a frequency response down to zero hertz, thanks to its DC-coupled signal path.

by ROB EVANS

In the May 1989 issue of *Electronics Australia* we described a small and inexpensive unit called a 'Versatile Subwoofer Adaptor', which was designed to take the signals from an existing amplifier's speaker terminals, and convert this to a line-level signal suitable for driving a separate amplifier and subwoofer combination. With the added feature of 'bi-phase' outputs for driving a stereo amplifier in bridged mode, the unit seems to have satisfied many constructors' needs for a low-cost but effective way to add a subwoofer to an existing sound system.

Despite the substantial number of these adaptors in service however, we've received a steady stream of requests for some easy way to convert the circuit to run from a single-ended DC power source (say 12V), rather than the 9V AC plugpack stipulated in the original design.

And in short, this demand appears to come from two distinct groups: those who wish to power the adaptor from an existing piece of hifi equipment (say, the amplifier used to drive a subwoofer) which does not offer a suitable low voltage AC source, and those who would like to use the adaptor when adding a subwoofer setup to their car sound system.

Looking back at the original May '89 design, we could see that perhaps the simplest way to change the circuit to run from a single 12V DC supply was to bias the signal path at half of the supply rail (6V), and use AC coupling in the input and output signal path. While this fulfils the basic need for a single supply rail, unfortunately it falls short in the areas of maximum output swing and its behavior at low frequencies.

More specifically, with this type of supply configuration the circuit's opamps would only be able to provide an output swing of about 5V peak or 3.5V RMS, since their output stage can only swing to within about 1V of the level at their supply pins — 0V and 12V in this case, which results in a maximum range of from 1V to 11V, or 10V peak-to-peak. While 3.5V RMS is still a reasonably healthy maximum output level, we felt that this would not provide sufficient signal 'headroom' for amplifiers with a low input sensitivity or those which use a variable attenuator in the input stage.

The second restriction regarding the circuit's low frequency conduct comes about through the necessary use of coupling capacitors in this single-supply approach. Since we are dealing with a circuit that processes signals for a *subwoofer* system, the output capacitors in particular must be quite large in order to guarantee that very low frequency signals are passed to the subwoofer amp without attenuation. For a response down to say 2Hz, for example, into an amplifier with an input impedance of around 600 ohms, our circuit would need output capacitors in the order of 220uF.

While this is not an impractical value to use, the substantial capacitance involved means that it will charge up relatively slowly when power is applied to the circuit. And in practice, this means that a large low-frequency transient signal will be passed to the following amplifier — which will duti-

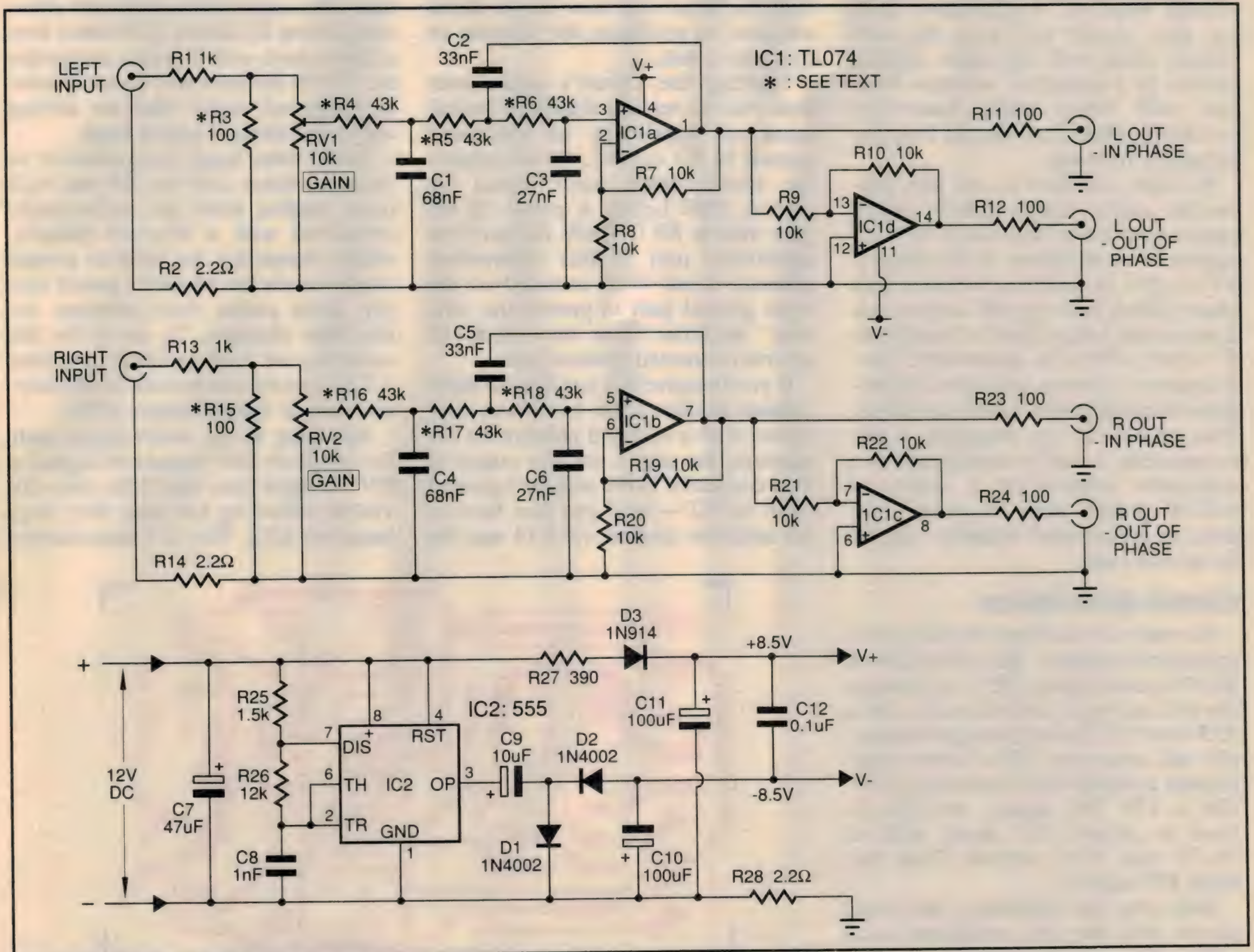
As you can see from this internal photo, the PC board is supported behind the case front panel by the connection wires attached to the rear of the RCA input and output sockets. This is feasible as it's very light in weight.

fully drive the speaker into large cone excursions. What we're really talking about here is a very large and possibly destructive 'turn-on thump' through the speakers...

As this is clearly an unsatisfactory state of affairs, we decided that our final circuit would need to employ some kind of signal muting circuit to automatically disable the output during the power-on and off sequence, or use a split power supply arrangement (+ve *and* -ve rails) so that the troublesome coupling capacitors are no longer needed.

Further research quickly showed that the latter option was undoubtedly the way to go, since the signal muting alternative would have forced us to add a substantial amount of extra circuitry — and of course did not solve the problem of a marginal output level capability.

So as you've no doubt gathered, our final circuit uses a simple negative supply rail generator to satisfy the split rail requirement. And as we've also taken steps to ensure that both the positive and negative supplies rise to their nominal voltage in a fairly balanced manner, the circuit's opamps produce very little in the way of disruptive transients during a power-on (or power-off) sequence. Plus, the resulting



Each channel of the adaptor consists of an input stage which can be configured as either a low pass filter or a buffer, depending on what you need. This is followed by an inverter stage, used to provide an anti-phase output.

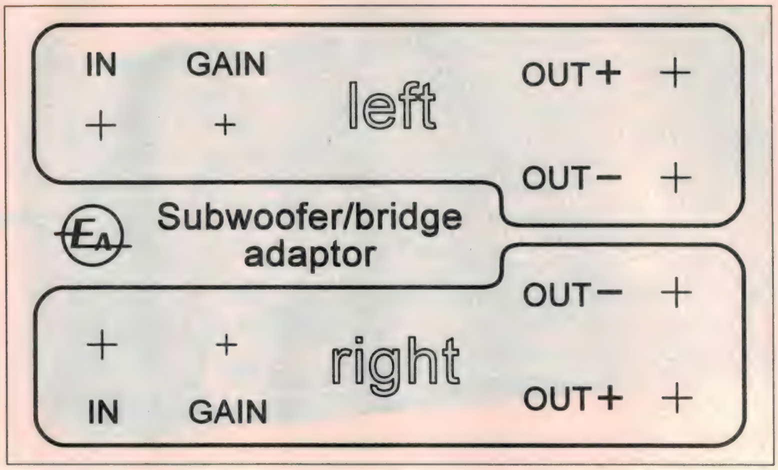
increase in the opamp's overall supply voltage means that the circuit can produce a larger output swing before clipping occurs.

The only remaining design consideration involved the type of low-pass filter that would be best suited to this application. Since this new adaptor will probably be hidden away inside an existing unit or under a car dashboard/seat/parcel-shelf, we have dispensed with the variable crossover frequency control offered by the May '89 unit, which in turn has allowed the use of a three-pole (rather than two-pole) filter arrangement.

The original circuit was restricted to a two-pole (-12dB/octave) filter so that a standard dual potentiometer could be used to vary the cut-off frequency, by the way.

With a three-pole filter offering a roll-off slope of -18dB/octave then, the new circuit will help the subwoofer mesh with the main speaker system in a smoother acoustic manner, with fewer phase anomalies occurring where their output frequency ranges intersect.

So there you have it, our new subwoofer and/or bridge adaptor which can be powered from a single 12V DC supply — or anywhere in the range of 9V to 15V, in practice. It draws only about 50mA from the DC source, has a maximum output level of more than 5V RMS, offers an unrestricted low-frequency response and does not produce harmful power on/off transients. Plus of course, by changing a few components it can be configured as a subwoofer adaptor (at a variety of roll-off points) with 'bi-phase' outputs, or a dedicated bridging adaptor in its own right.



Here is the artwork for the adaptor front panel, reproduced actual size so that you can use it for making up your own panel.

Circuit description

As you can see from the adaptor's schematic diagram, the circuit uses a TL074 quad opamp (IC1) to process the left and right audio signals, and a 555 timer (IC2) for the negative supply rail generator. This latter stage creates a supply rail of around -8.5V (for a 12V DC input), and this is used to power IC1 along with a +8.5V rail (V+) derived from the main DC supply.

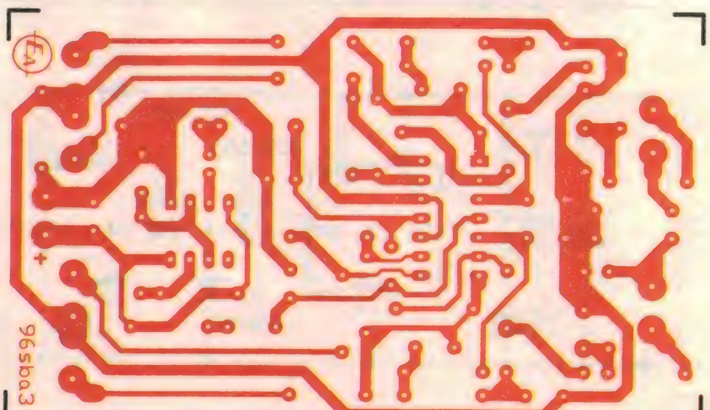
Note that the schematic has been drawn with the unit configured as a subwoofer adaptor that accepts speaker level input signals, but both the bridge adaptor and line-level input options can be selected by omitting particular components. See later for details on how this is done, and how to configure the adaptor to suit your needs.

Tackling the circuit's audio path first, you can see that signals at the left input are applied to an attenuator formed by R1 and R3, which reduces the speaker-level input signal by around 20dB before it passes to the gain trimpot RV1. While R2 plays no significant part in this attenuation process, it has been included in the input ground path to protect the 'driving' amplifier from the effects of reverse connected speaker leads.

If you imagine that just the left input channel speaker leads have been connected with a reversed polarity for the moment, the amp's positive output is then connected to the adaptor's ground point via R2 — or if you like, back to the amplifier ground via R14 and the negative lead of the right speaker connection. So with this type of wiring error, the amp's left output will effectively drive R2 and/or R14 rather than a direct short, which in turn means that the 0.25W resistors will be overloaded or destroyed, rather than the driving amp's left channel output stage.

On the other hand, there could be an occasion where *both* the left and right input speaker leads are inadvertently connected with a reversed polarity, which means that the short to ground would be via the adaptor's power supply leads rather than between the amplifier channels. To cover for this scenario, we have included a further 2.2 ohm sacrificial resistor in the adaptor's power supply section (R28).

Returning to the audio signal path, the relatively low impedance signal at RV1's wiper (less than 2.5k) then drives the following low pass filter stage based on IC1a. This is a conventional



And here is the artwork for the PC board, again reproduced actual size so that you can use it to etch your own board.

third-order 'Sallen and Key' arrangement, which offers a nominal cut-off point of around 90Hz, a roll-off slope of -18dB per octave and a gain of 6dB in its 'pass' band.

The main filtered output then passes from IC1a (pin 1) to both the 'in phase' output connector via isolating resistor R11, and a simple unity-gain inverting stage based on IC1d. This in turn feeds the 'out of phase' connector via R12, thereby providing the remaining half of the balanced output signals required for driving bridged amplifiers.

As you've no doubt gathered, the adaptor's right signal channel operates in an identical manner to the left section as described above, and incorporates the TL074's remaining opamp sections, IC1b and IC1c.

The adaptor's power supply section is based around a ubiquitous 555 timer chip (IC2), which drives a simple charge-pump circuit in order to generate IC1's negative supply rail V-. The (nominally) 12V DC supply source is applied directly to IC2 (at pins 8 and 1), which is configured as an astable multivibrator and is set to run at around 60kHz by components R25, R26 and C8.

IC2's squarewave output at pin 3 is then applied the charge pump circuit formed by C9, D1, D2 and C10, which produces around -8.5V DC when supplying the 10mA load presented by IC1.

While there are several ways at looking at the charge pump's operation, perhaps the simplest view is to to consider C9 and D1 as a level shifting or diode clamp scheme, and this converts (or moves) the 555's 12V to 0V output swing to a 0V to -11V swing — around one volt will be lost in D1.

The 'shifted' waveform is then half-wave rectified by D2 and the result filtered by C10. Note that a further drop of about one volt occurs in D2, leaving an *unloaded* output level of about -10V, which then drops to -8.5V in the actual circuit. R27, D3 and C11 are then used to derive the positive supply rail (V+) from the DC source, so that both its voltage level and turn-off decay characteristic match that of the negative supply rail.

With this arrangement, the voltage drop in R27 and D3 reduces the positive source to about 8.5V, and D3 will become reverse biased as the main DC power collapses — that is, when the unit is turned off. As the negative supply filter capacitor (C10) is similarly isolated by D2 at this time, both C11 and C10 will discharge evenly into IC1, causing both supply rails to drop in a predictable and matched manner.

The end result of this scheme is that IC1's opamp stages remain in a 'balanced' condition at turn-off, and therefore produce only very small transients and DC offsets — and in practice of course, this means a minimal 'thump' through the speakers. As it happens the power-on situation is similarly well behaved, since the value of R27 (390 ohms) roughly matches the internal 'source' resistance of the charge pump circuit, which in turn means that C11 is initially charged at about the same rate as the negative supply's C10. So when power is applied to the adaptor the supply rails rise in balanced manner, and again, the opamps will produce very little in the way of disruptive output signals.

Other than that, the remaining parts of the power supply circuit include the DC input filtering capacitor C7, supply rail bypass capacitor C12, and sacrificial resistor R28 (as mentioned above) which also serves to isolate the main power ground from the audio signal ground.

Configuration options

While the adaptor's schematic shows the unit configured as a subwoofer adaptor intended for speaker-level inputs, you can of course build the unit as a simple bridging adaptor, and/or change the input stage to suit line-level signals. To alter the left and right input sensitivity to match this latter option, just omit input attenuating resistors R3 and R15 — this will allow virtually the full input signal to pass to RV1, and sets the overall gain to around +6dB rather than -14dB.

If you have elected to use the unit as a bridge adaptor, the filter sections (based on IC1a and IC1b) will need to be converted into straight non-inverting amplifiers with a gain of 6dB. While the simplest way to achieve this is leave out the filter network components C1 to C3 and R4 to R6 (considering the left channel) then link the signal at RV1 to the opamp's non-inverting input, we would recommend that a degree of low-pass filtering is left intact. However this should be set beyond the audio band, as a 'supersonic' filter.

To setup the unit as a bridging adaptor then, R4 and C1 should be included as a simple first-order filter with a cut-off frequency set to just above the audio band, and the junction of the two components linked to the opamp's non-inverting input (pin 3). Values of 56k for R4 and 120pF for C1 will set the cutoff point to about 23kHz, and including link 'LK1' on the circuit board connects the filter output directly to the opamp input, as required. And of course, R5, R6, C2, and C3 do not need to be installed.

The right channel can be configured in the same manner, as you would expect, with R16 and C4 included as above, 'LK2' installed, and R17, R18, C5 and C6 omitted.

If you are building the adaptor in its subwoofer mode, you will also need to decide if the crossover's nominal 90Hz roll-off point suits your needs. Fortunately though this is very easy to change, and simply involves altering the value of R4 to R6 (left channel) from the 'default' value of 43k. There is an inversely linear relationship between this value and the crossover frequency, so the resistors can be simply scaled in value to set the filter to a different roll-off point — for example, doubling the value (82k) will *halve* the crossover frequency (45Hz).

To help you with this process, we've

TABLE 1
Roll-off options

R4-6, R16-18	Roll-off point (approx)
30k	125Hz
36k	110Hz
39k	100Hz
43k	90Hz
47k	80Hz
56k	70Hz
62k	60Hz
75k	50Hz
91k	40Hz

TABLE 2: Configuration options

CONFIGURATION	R3,15	R4,16	C1,4	R5,6,17,18	LNK1,2	C2,3,5,6
Subwoofer adaptor	100 ohms	As above	68nF	Include	Omit	- speaker-level in
Subwoofer adaptor	Omit	As above	68nF	Include	Omit	- line-level in
Bridge adaptor	100 ohms	56k	120pF	Omit	Include	- speaker level in
Bridge adaptor	Omit	56k	120pF	Omit	Include	- line-level in

Subwoofer/Bridge Adaptor for 12V

included two tables covering all of the options and variable parts in the adaptor's circuit — see Tables 1 and 2. However note that you should make a firm decision on the roll-off resistor values (Table 1) in particular *before* beginning the construction process, as these components will be difficult to change when the adaptor is fully built.

PARTS LIST	
Resistors	
(All 1/4W)	
R1,13	1k
R2,14,28	2.2 ohms
R3,15	100 ohms (see text)
R4-6,16-18	43k (see text)
R7-10,19-22	10k
R11,12,23,24	100 ohms
R25	1.5k
R26	12k
R27	390 ohms
RV1,RV2	10k horizontal trimpot
Capacitors	
C1,C4	68nF MKT
C2,5	33nF MKT
C3,6	27nF MKT
C7	47uF 25V PCB-mount electrolytic
C8	1nF MKT
C9	10uF 16V PCB-mount electrolytic
C10,11	100uF 16V PCB-mount electrolytic
C12	0.1uF MKT
Semiconductors	
D1,2	1N4002 power diode
D3	1N914 signal diode
IC1	TL074 quad opamp
IC2	555 timer IC
Miscellaneous	
Plastic or metal case, 130 x 68 x 41mm or similar; PCB coded 96sba3, 92 x 55mm; 6 x panel-mount RCA sockets; tinned copper wire, hookup wire.	

Construction

With the exception of the six panel-mount RCA sockets, all of the adaptor's components fit onto a relatively small printed circuit board, which is coded 96sba3 and measures 92mm x 55mm.

As you can see from the associated photographs, the PCB is supported by wire stalks attached to the RCA sockets, which in turn mount into the lid of a standard low cost plastic utility case.

Thanks to this construction method, the adaptor's PCB assembly is quite self-contained and therefore not really tied to any particular box or housing. While we used a common medium-sized zippy/jiffy box (41 x 68 x 130mm), there is no reason why the adaptor assembly could not be installed in a larger case, a metal box, or even inside some existing unit.

Begin the PCB assembly construction by installing the lower profile components first, in the usual way, while referring to the component overlay diagram at all times — don't forget LK1 and LK2 if you are building the unit as a simple bridge adaptor. Also note that the sacrificial/isolating resistors R2, R14 and R28 should be fitted with their bodies well *above* the PCB surface (say, elevated by around 3mm), so that they cannot burn or damage the PCB in the unlikely event that they are destroyed...

Other than that, take the usual care with the physical orientation of any polarised parts such the semiconductors and electrolytic capacitors, and again, use the component overlay diagram as a guide when installing the remaining components.

Before attaching the PCB to the RCA sockets as the final assembly step, we would recommend that you perform a few basic electrical checks on the circuit, since any construction errors are most easily corrected at this point. First, connect a 12V DC source to the appropriate PCB pads (take care with the polarity), and use a multimeter to check that V+ and V- supply rails come up to around +/-8.5V when power is applied. The actual voltage levels are not overly critical, but should be reasonably close to these figures.

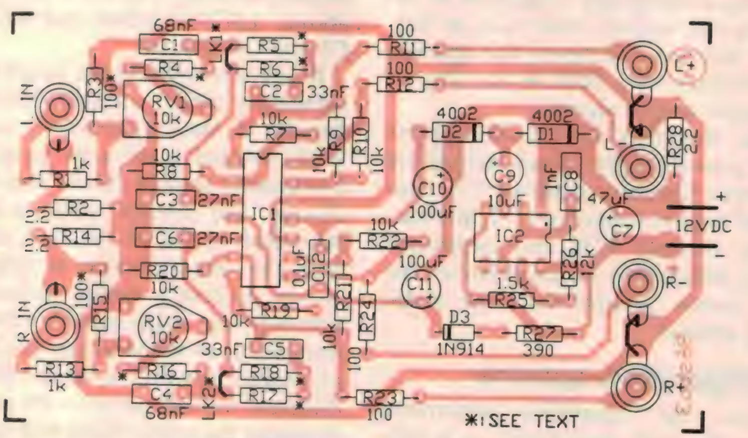
Next, check that each opamp output in IC1 (pins 1, 7, 8 and 14) measures within a few millivolts of 0V, as this confirms that the DC biasing within the audio path is behaving correctly. If all is well in the DC sense, then the AC (that is, signal) path is likely to be responding as expected.

You can also try the circuit with actual audio signals of course, and this will fully check that your construction has been successful.

The RCA sockets can now be installed in the box panel and lengths of tinned copper wire attached to their lugs as indicated in the photos and component overlay diagram. Note that there is only one ground lead passing to the PCB from each set of RCA output sockets (OUT+ and OUT-), so a small link will need to be added between the ground lugs on each set.

You should end up with 10 lengths of wire protruding from the RCA sockets, and these should all be trimmed to different lengths so that they are easy to guide into their matching PCB holes. Then just slide the circuit board onto and along the wires until the tallest PCB components (probably the 100uF electrolytics) are just touching the box panel's inside surface. Finally solder each wire to their PCB pads and trim the excess.

As one last point, it's worth noting that if you have used an aluminium Dynamark label for the front panel artwork, the bodies of the six RCA sockets will be electrically connected via the panel itself. This in turn means that the safety/isolating resistors R2 and R14 are effectively bypassed by this connection and will not perform their intended role, so you will need to be *very* careful when connecting input speaker leads. An alternative might be to fit insulating bushes to each RCA socket during construction. ❖



Use this overlay diagram as a guide when you are wiring up the adaptor PC board. Note that everything mounts on the board apart from the RCA sockets.

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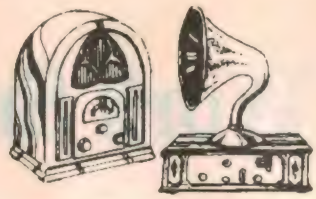
READER INFO NO. 16

Vintage Radio

by PETER LANKSHEAR



Diode detectors

All radio receivers, no matter how simple or complex, have one essential feature — a detector. Before the mid 1930's a variety of detectors were used, with varying degrees of success. But then, the diode found increasing favour, until today its use is universal. However, like so many devices that appear to be simple, its operation is actually quite complex...

Early in the history of radio, the major problem in reception was devising a reliable means of converting the high frequency currents induced in the aerial, into a usable and intelligible signal. Unbelievably weird and wonderful devices were dreamed up, from freshly killed frogs' legs to capillaries filled with a deadly potassium cyanide solution.

One odd feature about many early detectors was that there was no clear understanding of how they worked. Most practical of the early systems was the coherer, a small tube of metal filings that, in the presence of RF voltages, clumped together to provide a low resistance path to direct current provided by a battery in series with a sensitive relay.

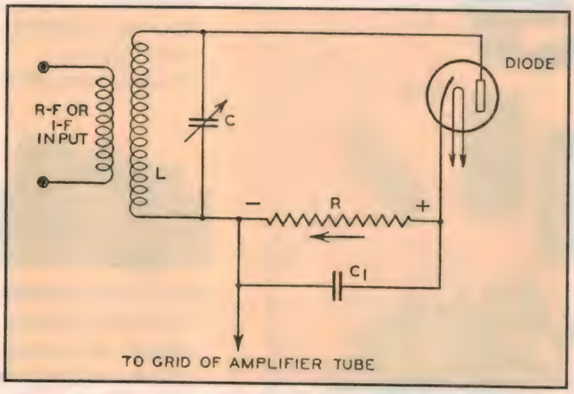
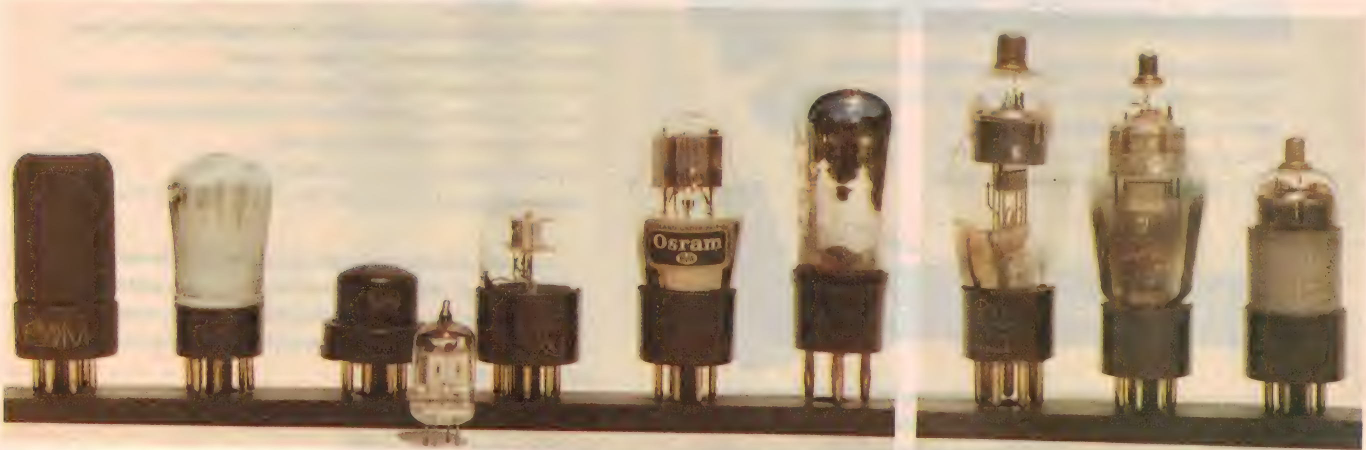


Fig.1: The basic diode detector is simply a half wave rectifier. Any one point of the circuit can be earthed, but it was usual practice for this to be the cathode.

Coherers gave no indication of the relative strength of the received signals, and could not discriminate against interference. In any event, the coherer proved to be so erratic that Marconi soon developed the 'Maggie' or magnetic detector, which depended on the changes in hysteresis of a moving iron wire band in a high frequency field. Listening on headphones gave the operator a much closer sense of reception conditions, and the computer between his ears was better able to interpret what was being received.

The problem was now that, although the magnetic detector was reliable, it was insensitive. A major step forward came in 1904 when Professor John Fleming, during research work for Marconi, tried out a some special lamps that Thomas Edison had given him.

Many years before, Edison had discovered the uniconducting properties of an incandescent lamp with a metal plate positioned near the filament. Fleming's experiments confirmed the



Left: A selection of double diodes. The Cossor DDL4 at the right dates from 1933, and the five octal valves are all variations of the metal 6H6. In the front is a popular 6AL5/EAA91 miniature double diode. Right: Three Australian designed diode pentodes. At the left is a 6B7S, with its 6G6G octal equivalent in the middle. At the right, with its integral lead shield, is the novel high gain 6AR7GT.

practicality of his 'lamp diode'. As a detector, it was more efficient than the magnetic detector and with consistent performance. But the filament required lighting and was subject to burning out, and before long, strong competition was coming from the various crystal diodes that evolved during the next few years. These were the first semiconductor diodes.

Meanwhile, little use was being made of the vacuum diode. Crystal diodes were at least as efficient, did not require a filament battery, and had the further advantage that they didn't burn out. Further, there seemed little point in making a diode valve, when, with a little extra effort, a grid could be included to make a much more useful triode.

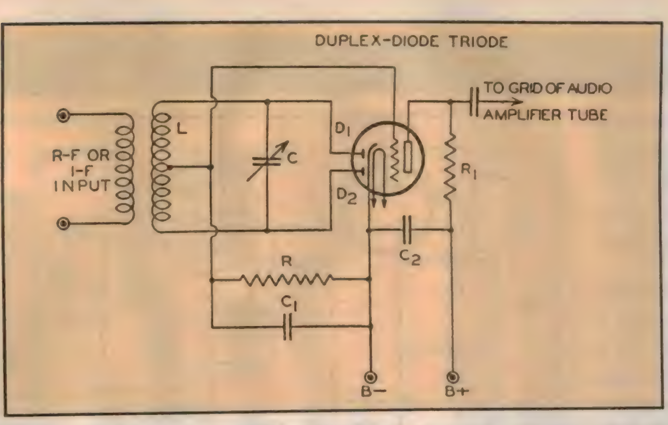


Fig.2: Full wave rectification had the advantage of not needing much IF filtering of the audio signal. In this circuit, direct coupling biased the triode grid from the rectified signal, but this was only suitable for low-mu valves.

Diode reborn

With its high sensitivity, especially with regeneration, the triode grid-leak detector was the universal detector for most of the 1920's. But by the end of the decade, several of its shortcomings were becoming apparent, and with the availability of the indirectly heated cathode valve, the biased or plate detector became the preferred type.

Then, shortly after 1930, the diode was rediscovered, and with its low distortion and ability to provide automatic gain control, it became pre-eminent. In the solid state form, it has remained so ever since, and the diode detector circuit has made the transition from valve to solid state technology with little change in the basic circuit.

At first, general purpose triodes were used as diodes, either with the anode and grid strapped together, or with the grid used as the diode and the valve anode earthed to provide shielding. But an obvious move was to make specialised detector diode valves.

Twin diodes in the form of power rectifiers had been around for some years, but in 1932, the Chicago firm of Grigsby Grunow produced the first indirectly heated detector double diodes — the type G-2S and the G-4S. Soon afterwards, in Britain, Mazda introduced the AC/DD, using the European standard four volt filament.

As diode detectors provide no amplification, an additional valve was necessary to maintain overall receiver gain; but this added to the receiver's price. It was not long before manufacturers made use of the surplus space within a valve envelope and added a general purpose triode — all sharing a common cathode.

Two types were produced, the only differences being the heater rating, 2.5 volts for type 55, and 6.3 volts for the type 85, and the combination proved to be immediately successful. As a resistance coupled audio amplifier, the triode, with characteristics similar to the ubiquitous type '27, provided a stage gain of 5-6 times, sufficient with local stations to drive a pentode output stage.

Meanwhile, British makers were not far behind and in 1933, most introduced dual function valves — but with a higher-mu triode than the American pattern, giving a stage gain of about 30 times.

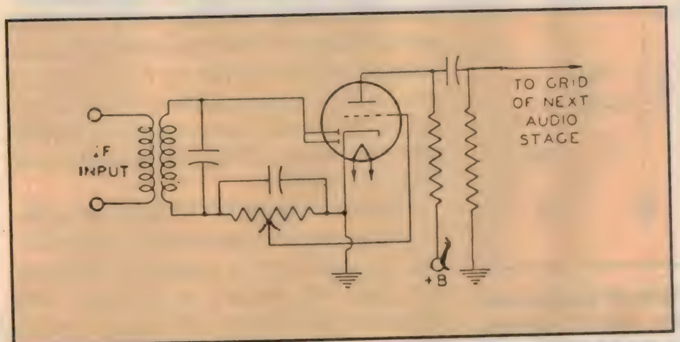
Insufficient gain

Combined with the higher gain output valves available to English receiver makers, this combination proved to be more than adequate. But with the advent of shortwave transmissions, the 55 and 85 were found to provide insufficient amplification, and so the 75 and 2A6, with an amplification factor of 100 times were developed.

Previously, about the only very-high-mu triode had been the type '40, with an amplification factor of 30 and an adaptation of the trusty '01A. But this had not been very successful. The new diode/triode on the other hand proved to be very satisfactory, and variations were in use in the majority of receivers for as long as valve radios continued to be made.

Another similar and very useful development, which appeared shortly afterwards, was the double diode/pentodes type 6B7 and 2B7. As resistance coupled amplifiers, the gain possible from these valves was similar to that of the high-mu triodes, but they had the added advantage of also being suitable for a combined IF amplifier and detector stage, and permitting designers greater flexibility.

There was special significance in Australia for the diode/pentode, for its popularity in reflex receivers, where the IF stage doubled as an audio amplifier. It is worth noting that two special diode/pentodes were developed in Australia for this application. First, the



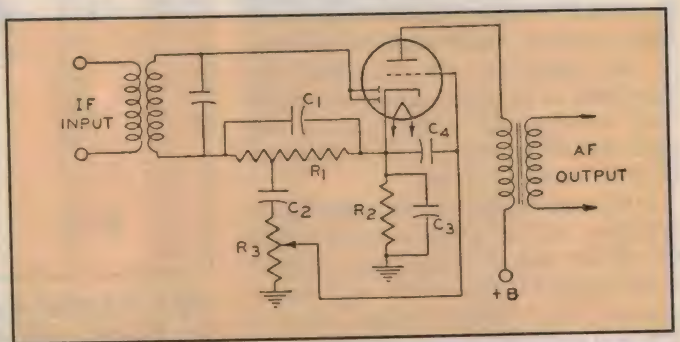


Fig.3 (left): In this variation of diode biasing, the volume control became the detector load resistor, varying the bias and applied signal simultaneously. Technically a good system, it could be noisy when the volume control was operated. Fig.4 (right): This commonly found system used automatic bias for the valve, and as the volume control did not carry any DC, noise was not a problem. However, distortion from poor AC/DC load ratios could be excessive.

6B7S and later its octal based equivalent the 6G8G, which were in effect extended variable-mu versions of the 6B7. Later came the unique higher gain 6AR7GT with its lead shielding jacket, which was also developed by AWV.

For a while during the early 1930's, some English made receivers used a non-vacuum diode about the size of a one watt resistor, the Westinghouse 'Westector'. This was a small copper oxide rectifier, which preceded the germanium diode by about 10 years.

The Westector was reasonably efficient — an example in the writer's collection still has a forward to reverse conductance ratio at 1.5 volts of about 150:1. Nowadays, modern solid state diodes are quite as efficient as their valve predecessors, and of course are in extensive use. In AM detector service, solid state and vacuum diodes are essentially interchangeable.

The diode detector is capable of excellent performance, with the ability to handle large voltages with low distortion, and in practice, the driver stage (usually an IF amplifier) will overload before the diode detector. However, design limitations, some of them avoidable, often considerably degrade performance.

Fig.1 is the basic circuit of the diode detector, comprising a tuned circuit, a diode and a resistive load. The circuit can be earthed at any point — generally the cathode. Operation with an unmodulated carrier is straightforward, the diode acting as a rectifier charging the capacitor to the peak value of the RF voltage present. Traditional, but not necessarily optimum, values of components are 100pF for C1 and 500kΩ for R.

The signal voltage from the IF transformer is applied to the diode anode and via C1 to the cathode. C1 charges up to the peak IF voltage. But due to the small time constant, modulation components of the signal are not smoothed out, appearing as an audio signal across the load resistor. An extra resistor and capacitor are generally used to filter out IF from the audio signal.

With a modulated carrier, operation is complex, but one useful concept is that the carrier and sidebands beat together in the detector to recreate the audio component. This is simple enough, but in a practical receiver, various complications and limitations can occur with detectors in common use. And as we will see, the standard diode detector is not always used to its best advantage.

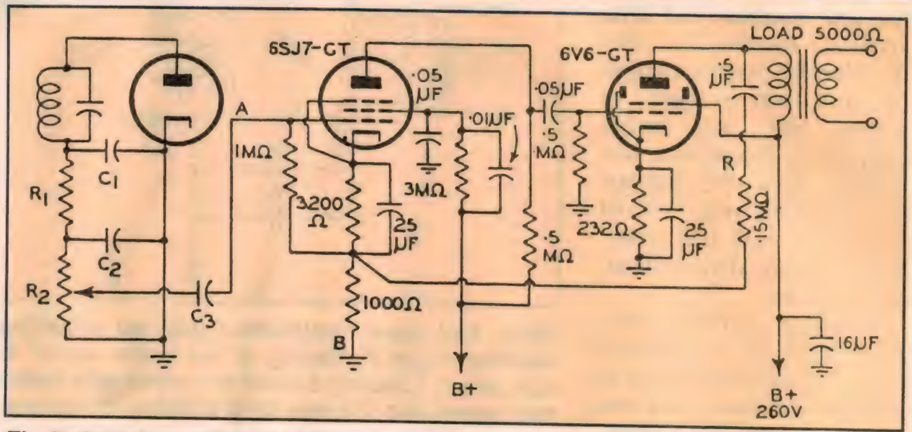


Fig.5: A high quality AWA circuit which overcame most of the detector distortion problems by raising the input impedance at point A by the 'bootstrapping' effect of the negative feedback voltage injected into the 6SJ7GT cathode.

At one time, as in Fig.2, full wave rectification was in fashion, with a diode connected to each end of the IF transformer secondary, and the audio taken from a centre tap. This halves the audio voltage, but simplifies the RF filtering.

There are several ways of coupling the signal to the first audio amplifier, and the method chosen will have a considerable effect on distortion. If, as in figure 2, the signal is connected directly to a low-mu amplifier grid with no coupling capacitor, distortion, even at 100% modulation will be quite low.

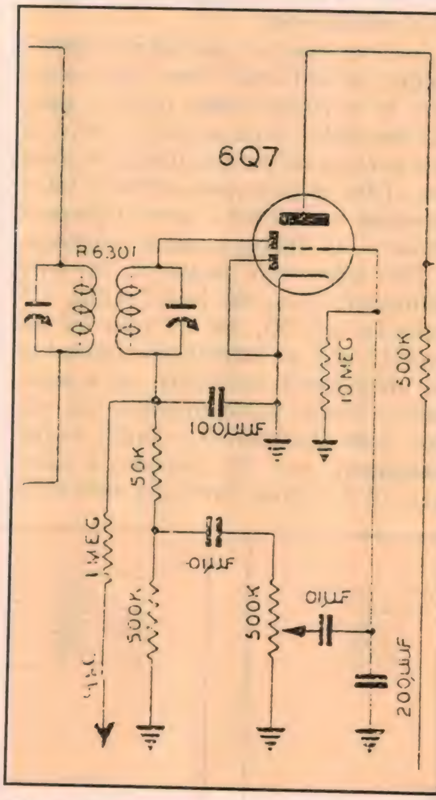


Fig.6: A typical example of bad detector design, with poor AC/DC ratios. Swapping the volume control pot over to the diode load position would improve matters, and it would have cost little more to use the spare diode as the AGC detector.

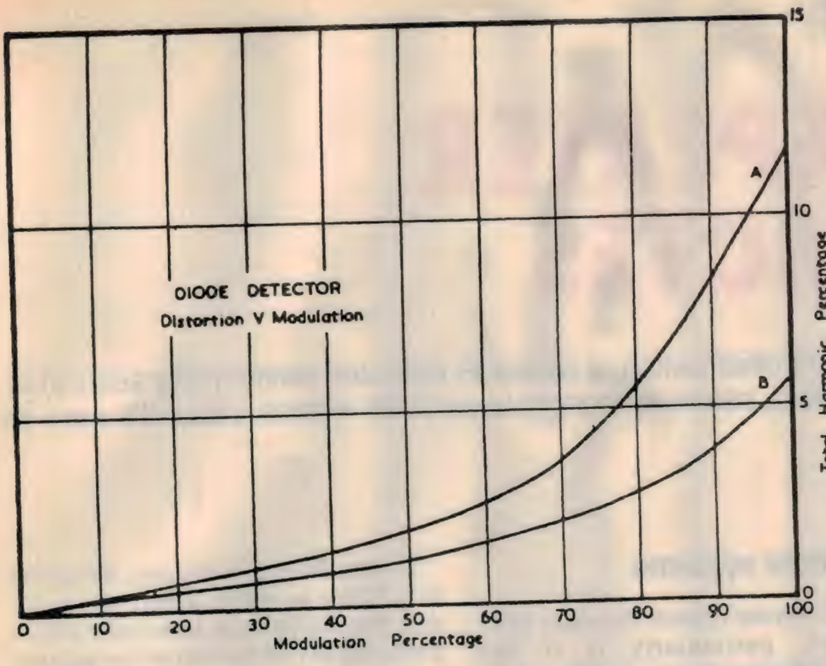
In what is known as diode biasing, the carrier generated negative voltage across the filter capacitor is greater than the peak modulation voltage, and serves to bias the valve. Although a very good system, diode biasing cannot be used with the high-mu triodes.

A more flexible arrangement is to make the diode load resistor the volume control potentiometer, as in Fig.3, with the moving arm connected to the triode control grid. Electrically, this is a good method, and as well as being used with the low gain triodes, it was used by RCA with the diode pentodes. It has one practical difficulty, though. The slightest wear on the potentiometer track creates noise as the volume is adjusted.

Serious distortion

With the adoption of the high gain triode audio stage, needing only a volt or two of bias, the wide variations in diode voltage, which can run up to 10 volts or more, made direct coupling of the diode load to the triode control grid no longer possible. Noise voltage alone could over bias the amplifier.

Alternative methods of audio amplifier biasing became necessary, with isolation by means of a coupling capacitor and grid leak resistor as in Fig.4. This capacitor and resistor connection, which effectively puts the grid resistor in parallel with the diode load, means that the diode has now different AC and DC loads. Analysis of circuit operation is complex, but the effect of this differen-



Curve B illustrates the distortion from a diode with a 0.5M load operating under ideal conditions. Curve A shows the dramatic increase in distortion when, as in Fig.4, the load is shunted by a coupling capacitor and 1M volume control.

tial loading is to create serious distortion at high modulation levels, and is dependent on the ratio of the loads.

The graph shows what happens with a typical diode load resistor of 0.5MΩ. Curve B is the performance expected with no additional shunting, as in the case with diode biasing, and can be regarded as acceptable. When, however, the load is shunted by a coupling capacitor and a 1.0M gridleak (a common value), curve A shows that distortion at modulation levels above 75% rises drastically. However, these curves apply to low and middle audio frequencies — at high modulation levels, the situation becomes even worse! At 5kHz the reactance of a 100pF capacitor is only about 300kΩ, a significant degree of shunting which can only exacerbate the distortion.

Modern transmissions have made this situation even worse. Prior to the mid 1960's, the only pre-transmission processing of radio programmes was basic peak compression of the audio, and average modulation of broadcast transmitters was low enough for this sort of diode performance to be acceptable to most listeners. But since then, the modern practice of using sophisticated audio processing — especially for commercial programmes — is now considered essential to keep a broadcaster's place in the sun. This actually raises positive going modulation peaks above 100%, with serious consequences for badly designed diode detectors.

The most common remedy is to make the volume control the diode load as in Fig.4. This has the effect at normal volume levels, of tapping the AC loading components down the load and improving the DC to AC ratio. The lower the volume setting, the better the ratio.

A further improvement can be made by the method shown in the AWA circuit in Fig.5. Here the grid resistor is returned to the negative feedback injection point, which the opposing feedback voltage 'bootstraps' — raising the apparent input impedance. A minor limitation is that this system of negative feedback cannot be used with an audio valve sharing its cathode with the diodes. The practical solution was to use a diode pentode in the IF stage.

Poor design common

Again, noise is a possible problem when the volume control is the load, and although with the use of good grade potentiometers many set makers used the system successfully, all too many took the easy option and settled for a 0.5MΩ load resistor and similar value volume control in the grid circuit. A typical example of such bad design is shown in Fig.6. Obviously, under these conditions, distortion at high modulation levels with modern transmissions will be rather noticeable to the discerning listener.

Some examples are even worse! In one English made receiver popular with New Zealand collectors, the designer really had a day off with the detector circuit. The diode load is a 0.5MΩ resistor coupled by the usual capacitor to a 0.25MΩ volume control!

But there's more! Note in Fig.6 how the AGC line feed, a 1.0MΩ resistor, is not fed from a separate diode, but is simply connected to the signal diode load. This has the effect of even further AC loading on the detector, and unfortunately was an all too common practice.

Post war audio stage biasing practice improved matters in some cases. There was increasing use of contact potential biasing, whereby the audio stage grid resistor was increased to about 10 megohms and the contact potential of about 1.0 volt was sufficient to bias the grid of a high-mu triode. Provided that the volume control was the load resistor, this was beneficial to AC/DC loading ratios.

Fortunately, there were good designs, and I am not advocating wholesale rebuilding of detector circuits. However, if a favourite set does sound 'rough' at high modulation levels, it just might pay to look critically at the detector AC/DC ratios. Even swapping the volume control from the grid to the diode circuit can be an improvement.

Next month we look at some low distortion detectors, and others that provide some gain. ❖

Construction Project:

SWITCH/REPEATER FOR IR REMOTES

This project can be a basic IR remote controlled switch, a coded IR operated switch (very secure) or an IR remote control repeater system that's sensitive to signals up to 25 metres away. It's easy to build, versatile and has a very low cost.

by PETER PHILLIPS

This project started out as a simple IR (infrared) remote controlled switch, in which a relay driven by the switch is toggled with each press of any key on virtually any IR handheld transmitter (like that used with a VCR or TV set).

However, the designers of the project (Oatley Electronics) have since sourced a special purpose ready-built IR transmitter (see Fig.2) with all the hardware and electronics that when combined with the basic switch, allow it to be used as a secure, coded IR switch or as an IR repeater.

Before going any further, first some basics on how infrared remote control systems work, as there's a bit more to it than you might expect. Then we can look at the project, which as you'll see has lots of possibilities.

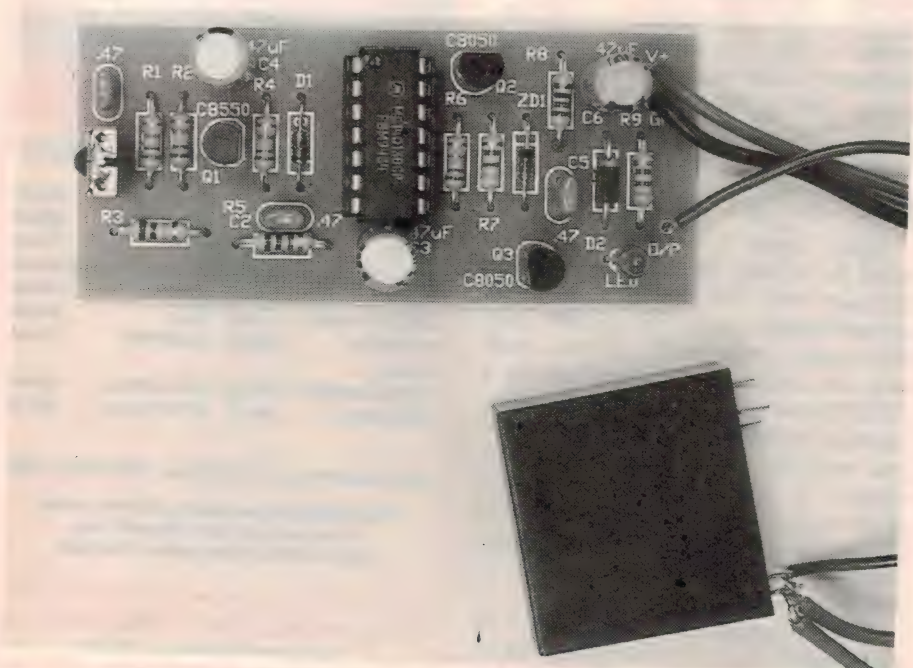
IR remote systems

An IR remote control system is quite complex, particularly if it has several functions (as most of them do). Each function in the system is represented by a digital code, which is a series of pulses (logic 1) and spaces (logic 0). In some cases the code is repeated as long as the particular transmitter key is pressed; in others the code is sent only once, regardless of how long the key is pressed.

The IR sensor in the receiver picks up the code, and decoding circuitry passes it to the required function. However, it's not enough to simply pulse the IR LED(s) in the handheld transmitter with the particular code, sending bursts of IR light towards the receiver. Instead it has to be sent on a *carrier*.

In most IR remote systems, the carrier is a 36kHz to 40kHz square wave signal. The digital code associated with a particular key on the transmitter *gates* or switches the carrier oscillator on and off. This oscillator drives the IR transmitting LED(s), so a logic 1 is sent as a number of carrier cycles, depending on the length of the pulse for a logic 1.

A carrier is needed to send the code, as otherwise the signal will not be distinguishable from other sources of changing light, caused by movement or the 100Hz flicker from lights, TV screens and so on. The IR receiver is 'tuned' to the carrier signal so its sensor can respond to the coded IR carrier frequency. The tuning is usually done with an RC bandpass filter, which is usually has a reasonably wide bandwidth (+/-5kHz).



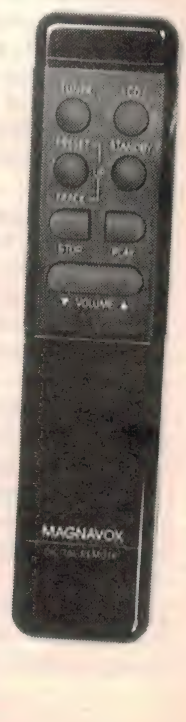


Fig.2: This low cost IR transmitter, available from Oatley Electronics, can be used to operate the IR switch.

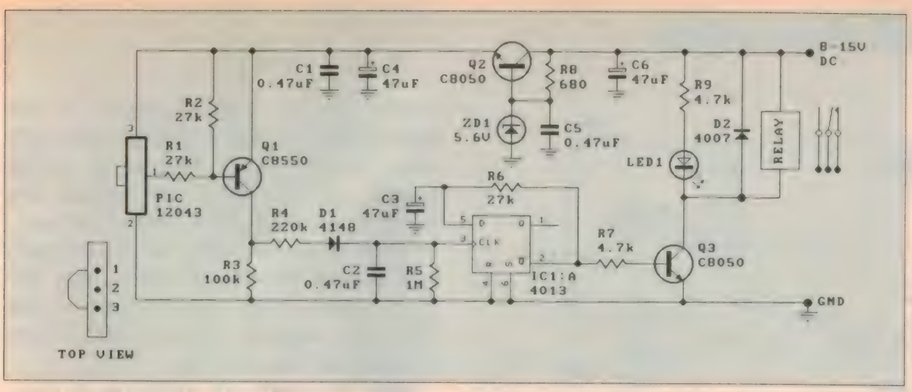


Fig.3: This is the circuit of the basic IR switch. The IR sensor is a three terminal IC with an inbuilt amplifier. It operates Q1 which clocks IC1, a D flipflop. The output of IC1 drives Q3, which in turn drives the relay.

When the transmitted signal is picked up by the sensor, it has to be amplified and the carrier removed, leaving the original digital code. This is rather like radio, where a high frequency (the carrier) is modulated with the required signal. The original signal is recovered in the receiver by a process called demodulation.

However, unlike most radio sets, an IR receiver doesn't have a tuning control, and is set to receive one frequency only.

This frequency is determined by the manufacturer of the system, which as we've already said, is usually between 36kHz and 40kHz. And as you can imagine, the IR receiver needs to be very sensitive, as the amount of IR light from a typical handheld remote control is quite low.

Now let's return to the project, starting with a look at the basic IR remote controlled switch.

Basic IR switch

The photo in Fig.1 shows the basic IR controlled switch. As you can see, it's connected to a relay that switches any load within the rating of the relay contacts.

The relay in the photo has contacts rated at 250V 8A, so it can operate a wide range of mains appliances, such as a light, TV set, VCR, hifi system or whatever. The relay is not mounted on the PCB, to avoid mixing 240V mains with the low voltage electronics.

Note that you should be qualified to work with mains voltages and mains wiring before connecting this device for switching mains appliances.

Incidentally, while the switch will work with almost any IR remote control transmitter, the special purpose transmitter in Fig.2 is ideal.

The circuit

The circuit diagram of the basic switch is shown in Fig.3. The IR sensor,

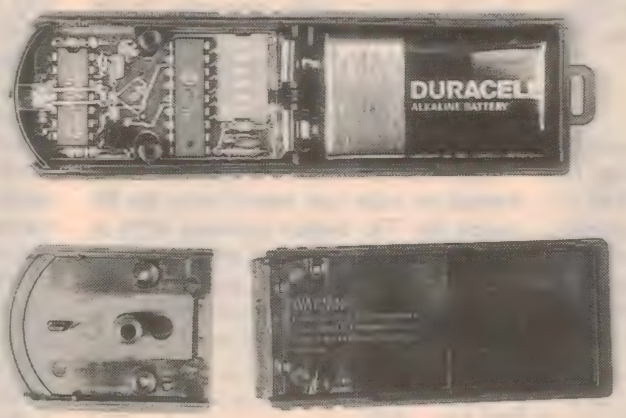


Fig.5: This shot shows the IR transmitter with its cover removed. It was originally part of an IR controlled alarm system and has 64 codes, selected with six DIP switches.

type PIC 12043 is a three terminal OPIC (OPtical Integrated Circuit) that incorporates a lens, photodiode, amplifier, bandpass filter, detector, automatic gain control and output buffer amplifier. Quite a fancy device, in fact! The output from the OPIC (pin 1) is the original digital signal sent by the transmitter. In other words, this relatively new device does virtually all the work!

The output of the OPIC is at pin 1, and the signal needs to be inverted to get the original code. This is done with Q1, where a low at pin 1 of the OPIC turns on Q1, giving a logic 1 at its collector. Of course, a basic IR switch like this one doesn't care what the transmitted code is. All it needs is a single logic 1 to clock the D flipflop of IC1a. However, all IR transmitters send codes containing a number of logic 1s. To prevent the flipflop responding to every logic 1 in the code, the signal at the emitter of Q1 needs to be *integrated*, or summed to give a single logic 1 per transmission.

This is achieved by the network comprising C2, R4 and D1. When the signal at the emitter is a logic 1, C2 is charged via D1 and R4. When it's a logic 0, D1 prevents the capacitor discharging. Of course C2 will discharge through R5, but at a rate that's too slow to significantly reduce its voltage while there's a signal at the emitter of Q1.

IC1a is a D flipflop connected as a toggle flipflop, with feedback via R6 from the Q-bar output to the D input. Capacitor C3 gives a time delay, preventing the flipflop toggling any faster than about once a second. This delay prevents the flipflop double-toggling if the IR transmission is interrupted.

The Q-bar output of IC1a connects via R7 to relay driver transistor Q3. When the output at IC1a is high, Q1 turns on, turning on both the relay and LED1. Diode D2 clips the back EMF from the relay coil, preventing it from destroying Q3.

The 5V supply for the OPIC and IC1 is regulated by the simple zener series regulator of Q2, ZD1, R8 and C5. This arrangement is cheaper than a three terminal 5V regulator and just as effective.

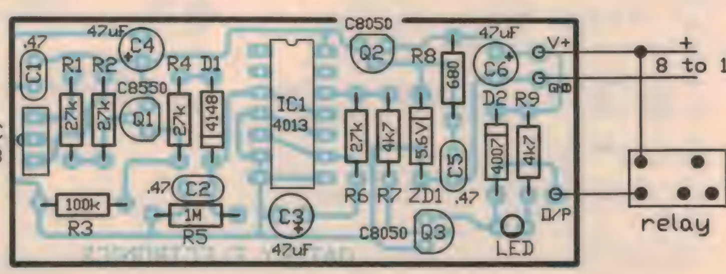


Fig.4: The PCB overlay/layout diagram of the basic IR switch. Use this diagram and the photo of the PCB (Fig.1) as a guide when building the switch.

Switch/Repeater for IR Remotes

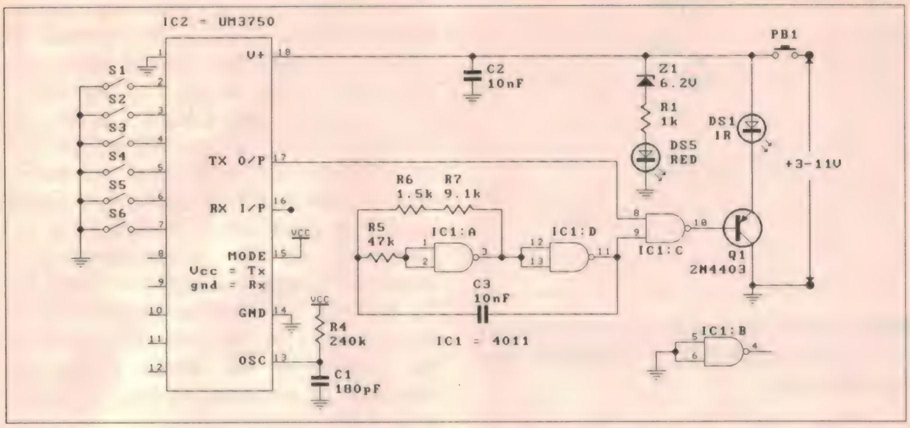


Fig.6: The circuit of the coded IR transmitter is based on a dedicated IC type UM3750. The rest of the circuit is a 38kHz oscillator and an IR LED output stage.

The relay and LED1 are powered from the 8V to 15V DC supply to the circuit.

As already mentioned, the relay is not mounted on the PCB to allow for different types of relays, and to keep any mains wiring away from the IR switch circuitry.

Construction

The complete switch is on a single PCB. Refer to the layout diagram in Fig.4 and the photo of the PCB (Fig.1) for details about component placement. As usual, mount the resistors and capacitors first, then the transistors, LED, diode and the IC. The OPIC is mounted so the lens points away from the PCB. Check the orientation of the electrolytics, diode, transistors and the IC before applying power to the circuit.

Before you add a relay, you can check that the circuit works properly. To do this, connect a suitable DC voltage (between 8 and 15V) and confirm that the LED toggles on and off with each press of any key of a typical IR remote control transmitter.

The rest of the construction will depend on what you intend using the IR switch for. The output transistor (Q3) is a low power device, and could be used to short an audio signal, perhaps as an IR operated muting switch. But most applications will probably need a relay,

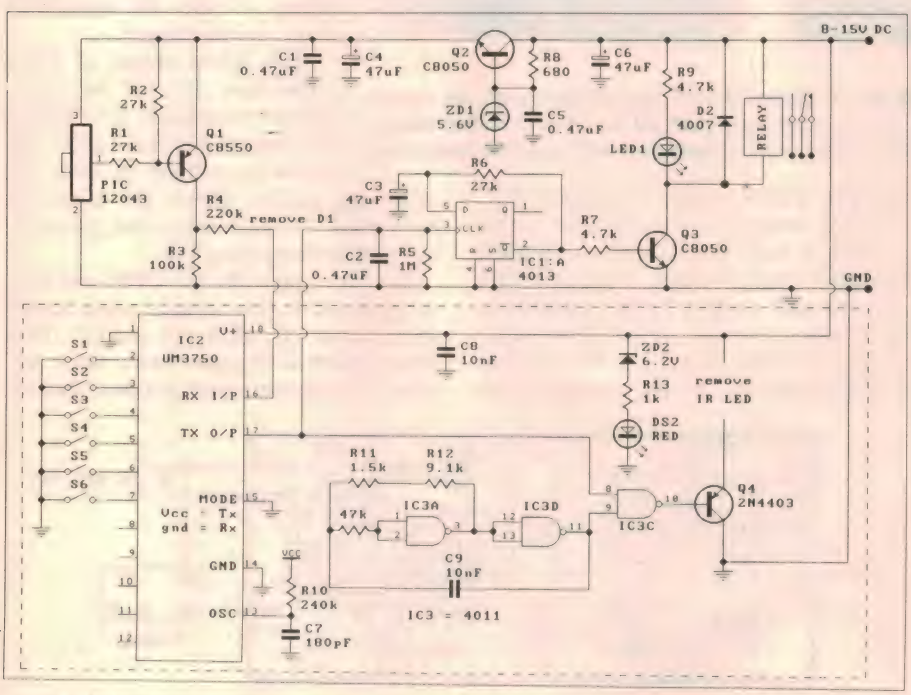


Fig.7: This circuit shows the interconnections between the basic IR switch and the coded transmitter (in dash outline) to get a coded IR switch.

which can be added as shown in the layout diagram. Make sure the relay will work off the supply voltage to the IR switch, and that the relay contacts are rated for the load you intend switching.

Keep all mains wiring well insulated, and mount the relay away from the PCB. Ideally you should enclose the PCB and relay in a plastic box. If you use a metal box, earth it.

Now let's turn our attention to combining the IR switch with the commercial IR transmitter mentioned at the start of this article. As you'll see, this opens up the possibilities quite a lot. We'll look first at the transmitter itself.

Coded transmitter

The transmitter is in a black plastic case measuring around 105 x 30 x 20mm and, as the photo of Fig.5 shows, has a small PCB powered by a 9V battery. It was designed to operate with other components in an IR remote controlled alarm system, and has six DIP switches to give 64 different codes. The circuit is shown in Fig.6.

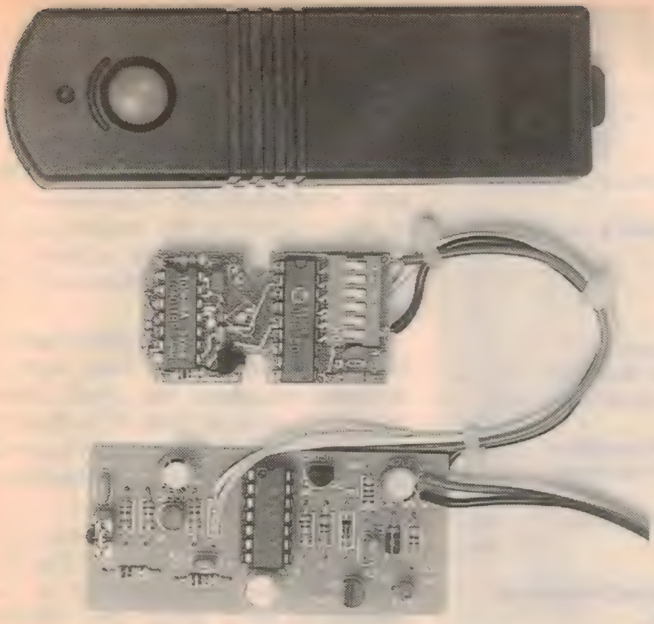
The main component is IC2, a dedicated IC that can be configured via its mode terminal (pin 15) as either a code transmitter or a code receiver. In the circuit, the IC is set as a code transmitter.

When power is applied to the circuit by pressing PB1, the code set by S1 to S6 appears in serial form at pin 17, at a rate determined by the IC's internal oscillator frequency. This frequency is set by R4 and C1.

The circuit around IC1a and d is a 38kHz oscillator, connected to one input of NAND gate IC1c. When the output of IC2 is high, the oscillator signal appears at the output of IC1c, turning transistor Q1 on and off at a frequency of 38kHz. The IR LED driven by Q1 therefore transmits a logic 1 as cycles of 38kHz, as described at the start of this article.

In other words, the oscillator output is gated by the serial code appearing at pin 17 of IC2, and the code is transmitted by the IR LED as a 38kHz carrier. The circuit is powered by a 9V battery, and Z1, R1 and DS5 (manufacturer's component numbering) form a battery voltage indicator.

While the circuit shows six switches, giving 64 different codes, earthing links can be soldered to other address pins (8-12) to give up to 4096 different codes. As well, changing the values of R4 and C1 (internal oscillator frequency) changes the nature of



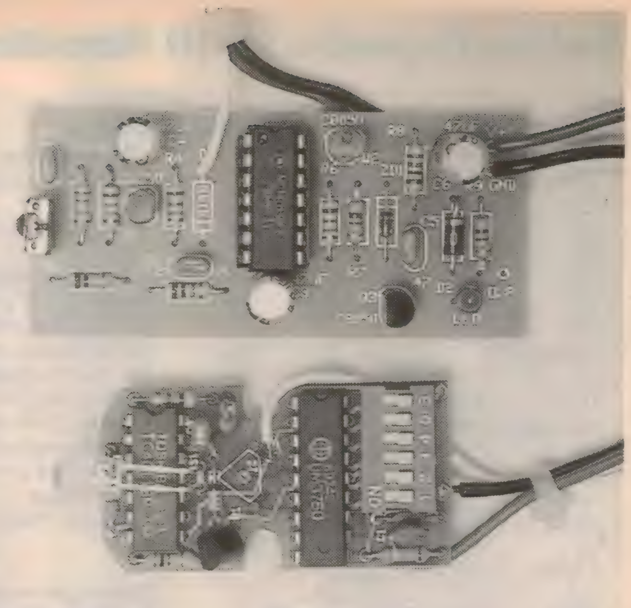


Fig.8 (left): This is the setup for a secure, coded IR switch. The codes of both the transmitter and the receiver are set with DIP siwtches, and must be the same. Four wires link the two PCBs. Fig.10 (right): This shot shows the interconnections between the transmitter and the switch PCB for the IR repeater.

the code, so the number of possible codes is quite large.

In the original application, the coding of each device controlled by the transmitter is set to correspond with the code sent by the transmitter. Now let's look at how this device can be incorporated with the basic IR switch.

Secure IR switch

A secure, coded IR switch operates only if it receives the right code. To get such a switch you need two coded transmitters and the basic IR switch already described. One of the coded transmitters is interconnected with the switch and the other is the 'key' to operate the switch. The connections are shown in Fig.7 and a photo of the arrangement is in Fig.8.

The output of the photodetector (in the switch) is connected to the receive input (pin 16) of the UM3750 in the transmitter. The UM3750 is configured as a receiver by connecting mode pin 15 to ground. The output of the UM3750 (pin 17) is connected to the clock terminal of the flipflop (IC1) on the switch PCB.

The IR LED in the transmitter is removed and both PCBs are powered by the same supply (8 to 15V DC). That is, there are four wires connecting the PCBs. Finally, the DIP switches of the 'key' transmitter and those in the interconnected transmitter are set to the same code.

In operation, when a code is sent by the 'key' transmitter, the OPIC receives it as already described, and the demodulated code is sent to the receive (Rx) input (pin 16) of the UM3750, via R4. If the received code agrees with the preset code, pin 17 of the UM3750 goes low, returning high when the transmission stops. The flopflop therefore toggles when you release the button on the transmitter.

The signal interconnections between the two PCBs are made by removing D1 on the switch PCB and soldering wires to the pads normally used by D1. These wires connect to pins 16 and 17 of the UM3750, on the track side of the PCB.

The transmitter PCB has an onboard switch which should be unsoldered and a link put in its place. Connect the supply leads to the battery terminals of the PCB.

When the wiring is complete, you should find that the LED on the switch PCB will toggle on and off only when the codes of both devices agree.

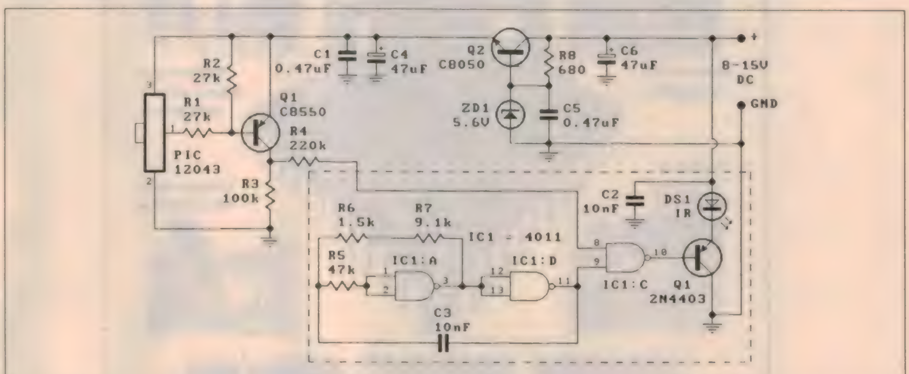


Fig.9: To make an IR repeater, the receiver's front end is connected so the received IR signal gates the transmitter's 38kHz oscillator, which in turn, drives the IR LED.

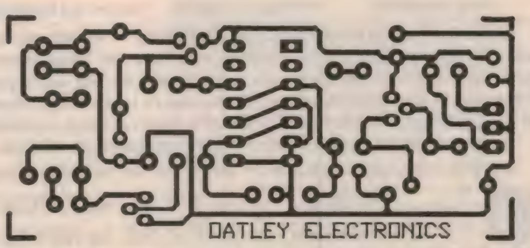


Fig.11: Here's the PCB pattern for the IR switch, if you want to make your own.

Switch/Repeater for IR Remotes

PARTS LIST

Resistors

All 1/4W, 5% unless otherwise stated:

R1,2,6	27k
R3	100k
R4	220k
R5	1M
R7,9	4.7k
R8	680 ohm

Capacitors

C1,2,5	0.47uF mono
C3,4,6	47uF, 25V electrolytic

Semiconductors

D1	1N4148 signal diode
D2	1N4007 1A diode
Q1	C8550 PNP transistor
Q2,3	C8050 NPN transistor
ZD1	5.6V zener diode
LED1	3mm red LED
IC1	4013 dual D flipflop
OPIC	PIC 12043 photosensor

Miscellaneous

PCB 70mm x 30mm; hook-up wire, solder etc.

A kit of parts for this project is available from:

Oatley Electronics
Phone (02) 579 4985
Fax (02) 579 3955
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.

Kit containing PCB and all on-board components for IR switch	$12.
Kit as above and one IR transmitter	$19.
Kit as above and two IR transmitters	$27.
OPIC sensor	$5.
12V relay, 250V 8A contact rating	$3.
P&P	$4.

Remember, you can hardwire other address pins 8-12 to get different codes to those available from the DIP switches.

IR repeater

An IR repeater lets you control an IR remote controlled appliance from another room. The repeater picks up the IR transmission from the handheld IR transmitter, and relays it to another transmitter located in the room when the appliance is.

A typical use for a repeater is with a VCR in one room feeding a signal to a TV set in another room. The repeater lets you control the VCR from the same room as the TV set.

An IR repeater can be achieved here by using the receiver section of the IR switch and the oscillator/transmit section of the commercial transmitter unit. Incidentally, the high sensitivity of the receiver in this project allows it to respond to most IR remote control transmitters over a distance of 20 to 25 metres.

As the circuit of Fig.9 shows, quite a lot of the circuitry of both sections becomes redundant. The circuit shows only those parts of both PCBs that are required, although it's probably easier to leave all the redundant transmitter components on board.

The operating principle is extremely simple, but most effective. The output from the photodetector is fed directly to pin 8 of the 4011 NAND gate on the transmitter.

The oscillator output is gated by the signal from the photodetector, driving the IR LED with pulses of 38kHz carrier. That is, the received code is re-transmitted on a 38kHz carrier, as explained before. The light output of the IR LED is quite high, as there is no current limiting resistor in the output stage.

To connect the two PCBs together, remove D1 from the switch PCB, and either remove the UM3750, or cut the track joining pin 17 of this IC to pin 8 of the 4011 (this track is on the component side of the PCB).

Then solder a lead to this track so pin 8 of the 4011 connects to R4 on the switch PCB. As described before, connect the supply to both PCBs. That is, there are three leads between the PCBs. A photo of the interconnections is shown in Fig.10.

The length of the leads will depend on the distance between the receiver and the transmitter. Typically the receiver should be placed so it can pick up the signal from the appliance's remote control unit, and the transmitter placed so it beams its IR signal to the appliance. This system will work with IR remote controlled appliances that respond to a 38kHz carrier, as most of them will. Otherwise, you might have to change the frequency of the carrier oscillator by changing the values of the timing components (R6, R7 and C3 in Fig.9).

The OPIC device has a broad bandwidth, so it will respond to virtually all commonly used IR carrier frequencies. Any problems will therefore usually be with the output carrier frequency.

So there it is, a versatile and inexpensive IR remote system that will do three very useful functions. ❖

Construction Project:

MULTI-SOUND SIREN

If you want your car alarm to sound different and to attract attention, this project is for you. Featuring eight different and attention-getting sounds, this siren produces an ear-shattering 120dB of sound.

by JEFF MONEGAL

One of the most important parts of any vehicle alarm system is the siren or sounding device, as it's the very thing that attracts attention if the alarm is triggered. Unfortunately we seem to have become hardened to siren noises, and these days most people tend to ignore an alarm siren, perhaps because of too many false alarms.

But car alarms are now more reliable, and a wailing siren is often telling the truth. So what we need is a sound that will attract people's attention — or at least deter a thief on the basis that the unusual sound is likely to attract attention.

The siren presented here is based on a dedicated sound generator chip that can produce eight different and attention-getting sounds. You can even set the chip so each sound is heard sequentially.

The available sounds are: rifle sound (repeated every second), shot gun (repeated every second), death ray, babu sound, ghost sound, bomb dropping from a plane, machine gun, laser gun. In fact the chip is not unlike the sound generator IC found in many children's toys. The difference here is that in this project, you get an output of 120dB! The sound of a machine gun at this level really attracts a lot of attention, and 120dB of 'ghost' is a sound that just begs investigation.

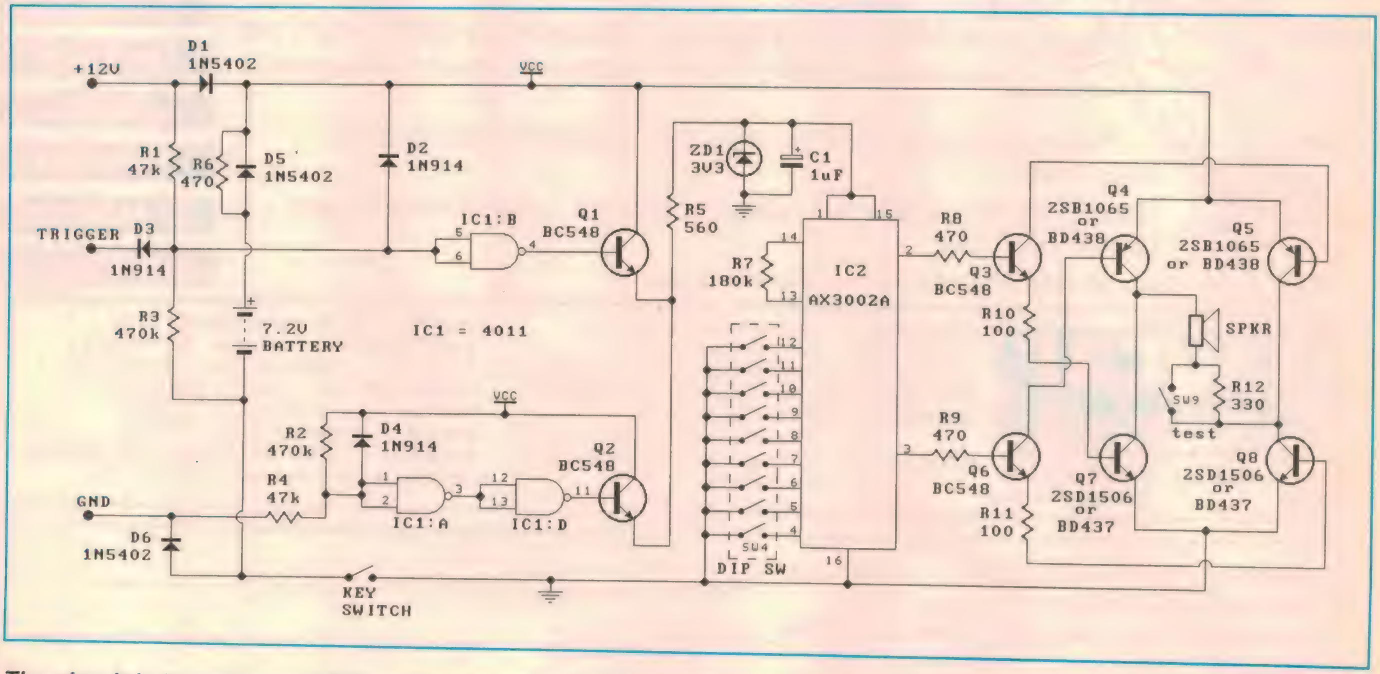
As with any professional quality siren, this design includes a rechargeable backup battery that sounds the alarm if the supply wires to the siren are cut. The battery is contained within the case, which makes it difficult to silence the siren once the cables have been cut.

The unit will interface to most car alarms and home alarm systems, and a key operated switch is included to disable the siren.

How it works

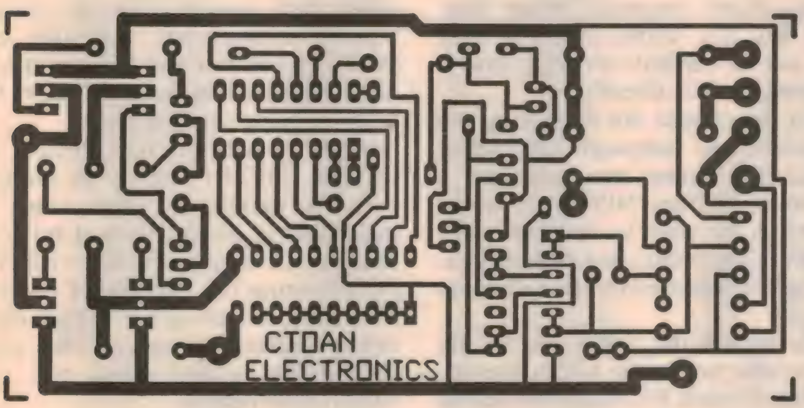
As you'd expect, most of the work is done within the siren generator chip IC2 (see schematic). The trigger circuit is around IC1, and the audio output circuit is the network of transistors Q3 to Q8.

Resistors R1 and R3 hold the input voltage of IC1b at close to the supply rail, and R2 and R4 hold the input voltage of IC1a at close to the ground rail. If the voltage at the trigger input to the siren goes low, the output of IC1b (pin 4) will go high, turning on Q1. As a result, power is supplied to IC2 via R5 and ZD1, which regulate the supply voltage to the required 3.3 volts.



The circuit is based around IC2, a siren sound generator IC. The trigger section consists of IC1 and associated components, and the audio output stage is the circuitry around transistors Q3 to Q8.

This 120dB siren has eight different attention getting sounds and includes its own backup battery.



The PCB pattern is given here full size, if you want to make your own board.

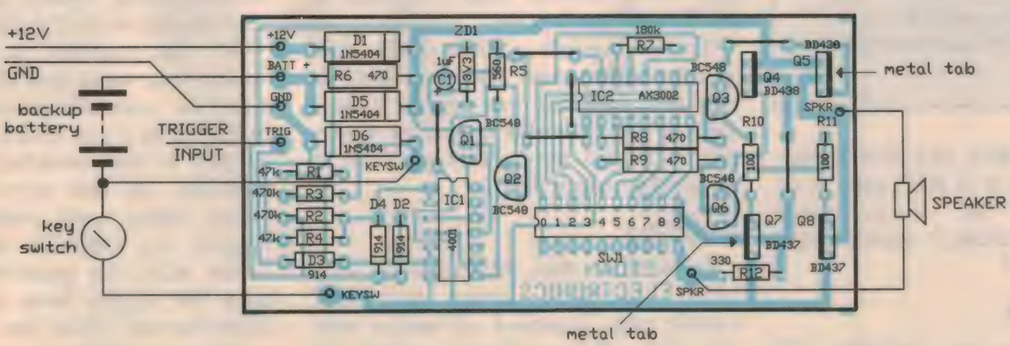
The sound generator therefore oscillates and produces the sound selected by the DIP switches connected to pins 4 to 12.

The audio outputs from IC2 are at pins 2 and 3, and are the complement of each other (180° out of phase). These signals drive the 'H-pack' speaker driver circuit. This circuit effectively doubles the supply voltage as far as the speaker is concerned, and gives a big increase in the output power compared to a conventional output stage. The end result is an extremely loud sound.

If the negative supply wire (ground) is cut, R2 will pull the inputs of IC1a high. The resulting low at its output is inverted by IC1d, turning on Q2 which again supplies power to IC2 as before. If the positive supply wire (+12V) is cut, R3 will pull the inputs of IC1b low, making its output high, turning on Q1 and again providing power to IC2. Diodes D2 and D4 protect the inputs of IC1 from high voltage spikes. The backup battery, a 7.2V NiCad pack, is trickle charged via R6, and powers the circuit via D5 if the 12V supply to the siren is cut. Resistor R7 sets the speed of the internal oscillator of IC2 and therefore the pitch of the sounds.

The 330 ohm resister (R12) in series with the speaker is there to lower the sound output from the speaker while testing the unit. When switch nine in the 10-switch DIP bank is closed, its contacts short circuit this resistor and full power is applied to the speaker. By opening switch nine, R12 is in series with the speaker, greatly reducing the volume so tests can be done without damaging your hearing and scaring the neighbours.

Each of the eight sounds is selected



Here is the layout of the PCB. As shown on the circuit diagram, either 2SB or DB type number transistors can be used for Q4 to Q8.

Multi-sound Siren

PARTS LIST

Resistors

All 1/4W, 5% unless otherwise stated:

R1,R4	47k
R2,R3	470k
R5	560 ohm
R6	470 ohm 1W
R7	180k
R8,R9	470 ohm
R10,R11	100 ohm
R12	330 ohm

Capacitors

C1	1uF 16VW electrolytic

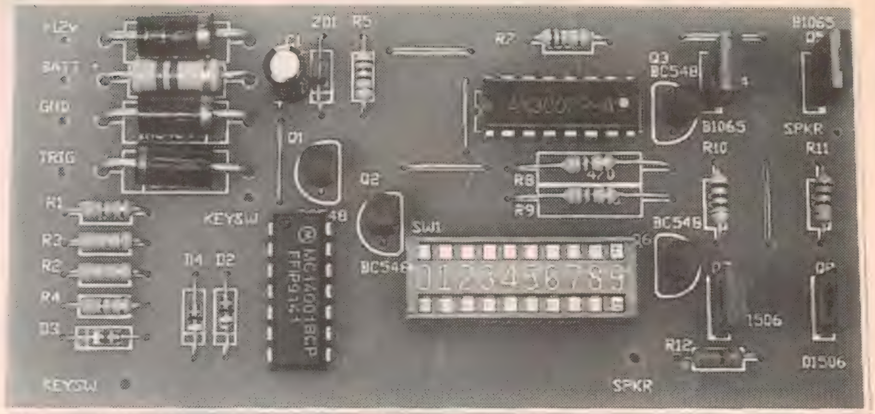
Semiconductors

Q1-3,Q6	BC548 NPN transistor
Q4,Q5	BD438 PNP power transistor
Q7,Q8	BD437 NPN power transistor
D1,D5,D6	1N5402 silicon diode
D2-4	1N914 silicon diode
ZD1	3.3V 400mW zener diode
IC1	4001/4011 CMOS quad NAND
IC2	AX3002P siren generator IC

Miscellaneous

PCB 105 x 50mm; plastic box 130 x 70 x 40 (Altronics cat H0203); key operated SPST switch; 8-ohm horn speaker (Altronics cat C2015); 7.2V NiCad battery pack (6 x AA cells); 10-way PCB mount DIP switch bank; nuts, bolts, wire, solder.

A short form kit of parts is available from CTOAN Electronics for this project. The kit includes a silk-screened solder-masked PCB, the siren generator IC and the four output transistors. Cost is $14.00 plus $3.00 postage.
A very small number of suitable NiCad battery packs are also available, priced at $10.00 plus $2.00 postage.
CTOAN offers a repair service for this project at a cost of $10.00, which includes replacement of IC2 if necessary.
Kits may be ordered using BankCard, MasterCard and Visa cards as well as cheque or money order from CTOAN Electronics, PO Box 211, Jimboomba 4280; phone (07) 297 5421.



This photo shows a close up of the PCB to help you during construction.

by the DIP switches, and switch four (connected to pin 4 of IC2) selects all sounds played as a continual sequence. If this doesn't attract attention, nothing will!

Construction

Construction is very simple. All components are mounted on a PCB, which we fitted inside a small plastic box. Follow the usual rules of mounting components: links, resistors, the capacitor and diodes first, making sure the diodes and the capacitor are mounted the right way round. Then mount the transistors and ICs (IC sockets are not essential, but they make repair easier).

The ICs are CMOS types, so take the usual precautions to prevent them being damaged by electrostatic discharge. (Earth yourself before handling the ICs, avoid touching their pins, use an earthed soldering iron if soldering the ICs directly.)

Also, be careful not to mix up the transistors, as although physically similar, the output transistors are a mixture of PNP and NPN types. In the prototype, the siren is attached to the bottom of the plastic box with its connecting wires passed through a hole in the box.

This means the wires are totally inaccessible unless the box is opened. The battery pack fits inside the box as well, under the PCB. Fit a piece of sturdy insulation between the battery pack and the underside of the PCB to prevent accidental shorts. A piece of PCB laminate is ideal.

The key switch is fitted to the case, and to allow room for everything in the box, drill the hole for the switch close to the lid of the box. This allows the PCB and the battery pack to fit under the switch body.

Testing

Remember that this siren is very loud! Therefore, make sure DIP switch nine is turned *off* before testing. This will significantly reduce the sound and let you make the various tests in comfort.

To test the unit, turn off the key switch and connect the backup battery. When the key switch is closed, the siren should sound (assuming the backup battery is charged). Remember that the siren sounds if the 12V supply lines are cut, which is the case here, as the 12V supply is not connected.

At this stage you could check out each of the eight sounds, and confirm they can be produced as a sequence when DIP switch four is closed. Finally, momentarily close the test switch to confirm that the sound output level increases dramatically, to the point of being ear shattering.

If all is well so far, connect an external 12V DC supply to the circuit. The maximum current taken by the circuit is around 1.6A at full volume, so the supply should be capable of delivering this amount of current. This time, assuming the trigger input is not connected to ground, the siren should not sound when the key switch is turned on.

However you should find that the siren *does* sound when the trigger input is connected to ground. As well, disconnecting either power supply lead should make the siren operate.

All that remains is to select the sound you want and to connect the siren to your alarm system. When installed in a car, make sure the 12V supply is not switched off by the ignition, as the siren will sound every time you switch off the engine. As well, fit a 5A fuse in series with the positive supply, or take the supply from a fused point from the car's fuse box.

Also, remember to switch off the siren if you need to disconnect the car battery. As well, use automotive grade cables for all wiring. ❖

READER INFO NO. 19

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Adelaide S.A. 5000

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INFORMATION CENTRE

by PETER PHILLIPS

Inside information on various items

We have quite a line-up this month, with detailed descriptions of LANs and CD players, more about 'universal' VCRs, another CDI circuit and discussion on our July '95 electrocardiogram project. As you'll see, this project has other applications...

As I explained last month, I like to change the format of this column wherever possible to give variety. This month we're concentrating on a few topics only. All the information has been supplied by readers, and given the credentials of the main contributors, I sure you'll find the letters informative and interesting.

Although the writers set out to answer a particular enquiry, the first two give considerable background that will be of interest to most readers. For instance, the first is about LANs, in which the contributor points out that my LAN adviser gave me incorrect information. I suspect there's quite a few LAN technicians who although expert in installing and maintaining a LAN system, are not familiar with the innermost technical operation of the system.

The second major topic is about CD players, in particular how to vary their speed (and pitch). Again the contributor gives a lot of background that describes how a CD player works — on the way debunking some of the market ploys to make you spend more money for enhancements that, according to the writer, don't do a thing!

Ethernet explained

In October '95 a reader asked about LANs and the effect of removing either of the 50Ω terminating resistors fitted to both ends of the LAN cable. I made enquiries and gave an explanation that, according to our next contributor, is wrong. I'm inclined to believe him, as his credentials suggest considerable experience in the field. So to put us right, here's an explanation of what really happens:

Concerning the discussion about LANs and SWR in October '95, your sources are totally wrong regarding the output impedance of Ethernet LAN cards. To a certain extent so is your conclusion that the system will not work if the SWR becomes high.

To better understand Ethernet systems we must go back a few years. During the late '70s, engineers at Xerox Palo Alto Research Centre (PARC) had been developing a 1Mb/s networking system using coaxial cable. Seeing the future potential of such a system, Digital Equipment Corp (DEC) and Intel joined with Xerox to form a group often known as DIX (DEC, Intel, Xerox) to further develop the concept. However they decided that a 10Mb/s system would be necessary.

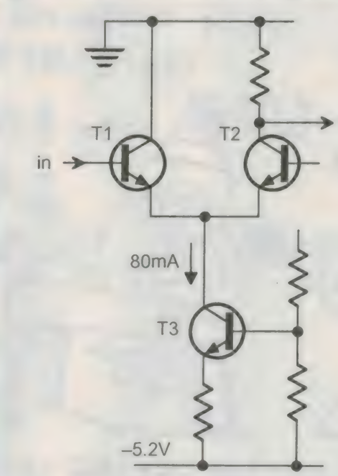

Fig.1

At that time 74xx series TTL ICs were all the go, but their speed was too low because they used saturated logic. Motorola however had developed a series of non-saturating logic that could operate at much faster speeds. This logic family, called emitter-coupled logic (ECL), often used differential long-tailed pairs where the coupling from one stage to the next was via the emitters.

Motorola called their series Motorola ECL or MECL 10000. These ICs operated from a -5.2V supply. To prevent saturation, the current in the differential pair was set by making the 'long tail' a constant current source. By correctly setting the constant current, the system could be prevented from saturating and so performed at very high speeds.

In Fig.1, T3 forms a constant current source. This constant current is steered either to T1 or T2 by the input to T1. T1 and T2 form the familiar differential pair. So what we end up with in the output load resistor is either no current, or the full current of the constant current source. T1 and T2 are basically non-saturating switches for the constant current.

A constant current source appears as a high impedance, in which the load current is not highly dependent on the value of the load resistor. Consider the example in Fig.2. The current through the two resistors is basically set by the 1M ohm resistor. Doubling or halving the value of the 50Ω resistor will do very little to change the current through the network.

So how does all this relate to Ethernet? The DIX group decided to use ECL logic to get the required speed. To provide a well-matched system, they chose 50Ω coaxial cable terminated at both ends. To operate this cable, the ECL ICs drive a constant current into the cable to provide one logic state, or no current for the other logic state. So basically Ethernet is a current driven system, in which the driving IC sees (essentially) two 50Ω terminations in parallel, or 25Ω. The current in the line is generally 75 to 80mA into the 25Ω load. This means the voltage on the cable is 0V for one state, and 0.08 x 25

or -2V for the other state. So if you put a high speed oscilloscope onto an Ethernet line, you will see pulses going from 0 to -2V.

Now, what about receiving? When a transmitter is not sending, it's in a high impedance state, so no current is put into the line. This means the receiver in that unit can listen to the line and see the signals from other transmitters as they go from 0V to -2V. But what happens when two transmitters come on at the same time? Basically, this results in both transmitters trying to put 80mA into the line together. The result is a voltage of -4V on the line.

So to detect collisions, the receiver monitors the voltage on the line as in Fig.3. If the voltage on the line exceeds the -2V level by any great amount, we can assume more than one station is transmitting at once, and so we know a collision has occurred. This is the whole basis of the collision detection aspect of the CSMA/CD protocol used on Ethernet.

Of course, all this is a very simplified explanation of the CSMA/CD Ethernet system, but it should help to clarify some of the points.

So, to answer some of the questions raised in your article:

1. Ethernet LAN transmitters exhibit a high impedance constant current characteristic.

2. If a terminating resistor is removed, the failure of the network is not so much due to the VSWR, but simply due to each station attempting collision avoidance. With only a single 50Ω termination, any station transmitting onto the network will produce well over the nominal -2V, so every station will recognise it as a collision. (Doug Rickard, Senior Technology Consultant, Upper Coomera, Qld)

Thanks for this description, Doug. I'm sure your explanation will be of interest to many, as knowing what is done is surely enhanced by knowing how it does it.

Varying CDP speed

You can hardly have failed to notice the long running discussion on how to vary the speed of the music from a CD player. We've had a number of letters, mostly advising us of people who do this sort of thing. But at last we have a full description of how you can do it yourself. As you'll read, it's relatively easy. The writer has had a lot of experience with CD players, and his explanation of how they work will interest you, even you don't want to vary its speed:

I have noticed some interest in your column concerning how to change the pitch of CD players. There are two methods to do this, which predictably are worlds apart in methodology. One involves rather complex digital signal processing but retains the original sampling frequency, while the other is much simpler to achieve but has the problem of changing the sampling rate — although if the CD player's analog outputs are being used, this is not a problem.

To understand how this can be done requires an understanding of how the digital audio signal is extracted and processed. It's important to first consider the timing system. As far as I know, all CD players have a quartz crystal as a master clock which controls the overall timing of data through the circuit. Usually this is either 192, 256, 384 or more recently, 768 times the sampling frequency. The 256 and 384 times are the most common, corresponding to a master clock frequency of 11.2896MHz (Philips) and 16.9344MHz (Sony, Yamaha, Matsushita etc) respectively.

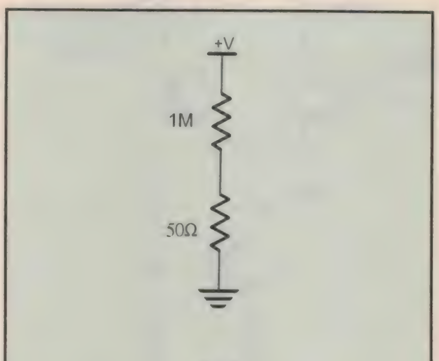

Fig.2

When a disc is playing, data from the laser goes to a PLL (phase-locked loop) decoder which tracks the frequency of the data read from the disc. After a number of processing stages the data stream minus certain flags is dumped into a RAM block for storage and de-interleaving.

The RAM controller can clock data in and out independently, rather like the true VRAM used in high-speed PC graphic accelerators, such as the ATI Mach64. The RAM block is needed to allow a number of data blocks or 'symbols' to be stored so the data can be unravelled. This is necessary as the data, prior to being recorded onto a CD, is jumbled up and intertwined to reduce the effects of scratches etc.

Once the data has been manipulated in the RAM block, it is fed to a digital filter (if present) and then to the DACs for conversion to analog audio, at a rate set by the clock-derived timing signals. These are all divisions of the master clock, which is a very stable quartz crystal oscillator.

The speed of the disc is determined by a circuit that looks at how much data is currently in the circular buffer arrangement of the RAM. If the buffer starts getting too full, it slows the disc to reduce the data flow into the RAM block. Conversely if the level drops too low, it speeds up the disc to top up the RAM.

The PLL of the decoder tracks the change in the incoming signal from the laser assembly using special sync patterns present in the raw data to specifically allow the PLL to remain locked to the incoming data rate. The PLL supplies the clock for data entering the RAM buffer, but the quartz crystal generates the clock for the data leaving the RAM block. Hence the RAM controller also acts as a clock interface between the stable clock (quartz crystal) and the variable clock (PLL). Since the data feeding the DACs is referenced to the quartz crystal, variations in the PLL clock are isolated by the RAM clock interface.

So long as the RAM buffer never overflows or underflows, the DAC will always have a continuous supply of data at a clock rate with quartz precision, which means no wow and flutter, and more importantly highlights the fact that small fluctuations in the disc's speed have absolutely no effect on the audio quality.

In fact, the disc speed varies from 500 to 200 RPM as the disc plays from the inner track to the outer track, because CDs use a constant linear track velocity as opposed to vinyl records which use constant angular velocity. It doesn't matter if the disc speed changes, because the memory controller will sense the deviation from 50% buffer level and adjust the disc speed to suit.

You may be wondering how some of the whizz-bang features on some players, like disc platters, belt drive systems and speed dampers can have any effect on the sound. The answer quite obviously is they don't — a marketing gimmick!

So by replacing the master clock with a variable frequency, the system servos will compensate automatically and track the new clock frequency, changing the rate of data flow to the DACs and hence causing a change in pitch, in the same way that changing the rotational speed of a record affects pitch.

If you have a circuit diagram of a player, locate the decoder IC and you might find a crystal connected to the XTAL1/input sense and XTAL2/output

drive pins. More common though is to have the clock generated at the DAC or digital filter, and a buffered clock output from these devices drives the decoder and other devices earlier in the processing chain, in a master-slave configuration. Either way, remove the crystal and connect an external adjustable frequency source such as a VCO to the crystal input sense pin.

I recommend the clock frequency be limited to about +/-10% to keep within the capture range of the system servos. If you are buying a CD player specifically for modification, I suggest you consider a machine which uses the well-proven Philips SAA7310 decoder chip (CD3) which is found in better quality machines, such as those from Marantz.

To demonstrate the setup, consider a Philips CD 950 which uses a Philips SAA7350 bitstream DAC with a 256x clock connected to pin 14 (Xin) of the SAA7350. The buffered pin 16 output (XSYS) connects to pin 2 (XTI) of the NPC SM5840A digital oversampling filter, which in turn buffers the clock, then outputs it on pin 4 (CKO) which drives pin 26 (Xin) of the SAA7310 decoder and pin 9 (Xin) of the PCF3523 digital audio output encoder. Having the master crystal oscillator at the bitstream DAC chip, which in turn feeds a Philips DAC-7 TDA1547 super bitstream converter, reduces the level of jitter-induced distortion because the clock source is right at the DAC chips.

Carefully removing the crystal and connecting the output of a VCO to pin 14 (Xin) of the SAA7350 bitstream DAC allows pitch control to be achieved in this machine.

To maintain the purity of the sound however, it's important to ensure the VCO is stable, with minimal jitter. Also, take the usual static precautions and use shielded cable to connect the new clock to the player's circuits.

Because the system sampling frequency is changing, the effective digital filter roll-off points also change because they derive their reference clock from the same source as the RAM. The analog output filters on modern sets usually roll-off at around 70kHz, so don't take the clock variation too high.

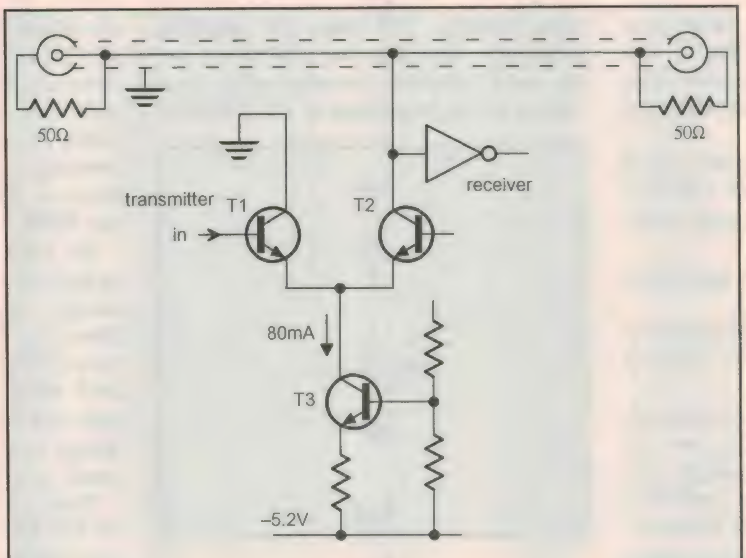

Fig.3

The alternative method is to digitally resample the signal, then change the ratio of samples-in versus samples-out. Because the output frequency has to remain at the record frequency of 44.1kHz, some of the incoming data has to be thrown away if the speed is increased, but other data has to be filled in if the disc is slowed down.

Throwing away every Xth data sample will give a change in speed but not pitch. However it will also create a significant level of intermodulation distortion unless each sample is passed through a complex algorithm to create a resampled signal. Likewise, creating missing signals by simple interpolation in a regular pattern will also create some audible harmonics unless a proper resampling system is used. Although they are commercially available, they are not cheap.

So if you want a speed change like that of a cassette deck or turntable (which causes a change in pitch proportional to speed deviation), then changing the master clock in the CD player is the simplest and cheapest way to go. Of course, user modifications will void any warranty on the player, so be sure it is working properly before making such a modification. The variable frequency source should obviously have a centre frequency the same as that of the crystal. (Stephen McBride, Townsville, Qld.)

So there you have it. Thanks Stephen, for this explanation, it not only answers a few questions but gives us a good description of how a CD player works.

There are now variable CD players on the market. One brand (Denon, I think) has a speed variation of +/-8%, which I assume is based on a variable clock frequency. Another type offers a wider range, up +/-50% according to my source, so it must use the alternative technique.

Multi-standard VCRs

The question of using a multi-standard VCR to convert between PAL and NTSC formats was raised in November, and I pointed out that most VCRs of this type don't do any real conversion, but rely on the TV set to do most of the work. I've since received two more letters on this topic, agreeing with my comments and advising me of commercially available VCRs that in fact do the required conversion. The first is from Stephen McBride (as above), whose expertise it seems is not limited to CD players...

In relation to the query in the November issue concerning video standards conversion, you are quite right in pointing out that VCRs that can play multiple formats of colour systems are not actually converting the format, but instead are relying on the TV's scanning circuits to synchronise themselves to the VCR; something older TVs can't do.

Granted the VCR has to change its colour burst reference method and timing parameters, but these functions are mostly contained in a couple of VLSIs in the VCR and are switched by a CPU signal.

If a VCR really can convert formats, it means you can use it to play back say an NTSC tape and connect the VCR AV outputs to a second PAL VCR, and have the second machine record the image onto the destination tape in PAL format, even though the source tape was NTSC. I have tried it with a number of so called multi-format VCRs and none of them have worked.

I have only ever seen one commercially available VCR able to do true format conversion. It was a National Panasonic machine, model WS-1000 (I think), as in

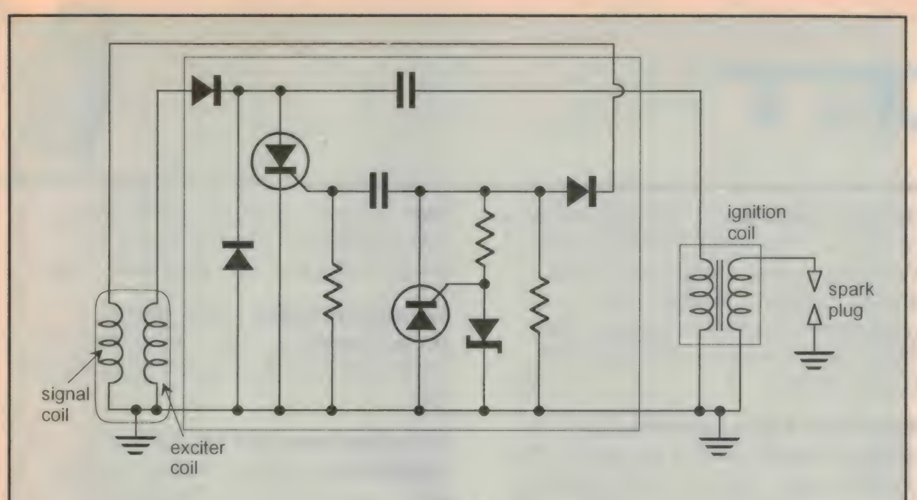

Fig.4

World Standards, or Worldwide Systems. Its price was around $4000.

It was a true digital format converter, so you could connect say a SECAM signal to its inputs, record the signal in PAL and output it in NTSC, all at once. It also played from very slow motion to very fast search forward and backwards, normal or half speed, with hifi and linear audio, and normal or Super VHS. I saw this machine in 1993, and at the time it was available from GEC Industrial. I assume a similar machine is still available. (S.M.)

Once again thanks, Stephen. The next letter also mentions a Panasonic VCR...

Regarding your comments in November '95 about a multi-standard VCR, I'm happy to inform you that there is such a VCR available, a Panasonic model NV-W1 unit that does all the world standards as well as long play, all in hifi stereo. It can also record in any standard, for example feed in a PAL signal and record it as NTSC. It doesn't have a TV tuner because of the many standards it handles. Most TV stations and video production houses have a machine like this. The price is around $3000. (Ross Hutton, Brisbane, Qld.)

I pointed out in November that I knew of another machine able to do all this, a Sharp WD1. So it appears there are three true multi-standard VCRs.

Electrocardiogram

Our July '95 PC driven Electrocardiogram has proved very popular with readers, judging from the number of kits sold by suppliers. The next letter is from a reader who it seems is using the design for other things:

I note that some correspondents don't think too highly of the safety of the PC driven electrocardiogram presented in July '95. However I have been intrigued by its design, simplicity and cheapness and have tried to use it as a simple A/D interface, using pin 3 of comparator IC3 as the input, without the preamp section. In testing out the design, I have made a few observations which may help others.

First, the ramp voltage from IC4, developed across R29 will range from the negative rail to two thirds of the voltage of the positive rail because of the specified resistor values. Since the output of IC2b will be centred between the two rails, a simple AC signal will not be able to go as low as the negative rail without exceeding the positive range of the ramp. This is probably the reason the program in lines 130 and 140 subtracts 110 from the variables. This provides the necessary offset for the signal, but nearly halves the A/D range.

If a second 10k resistor is connected in parallel with R34, it brings the common rail to the centre of the ramp, and permits the full A/D range to be realised, if the factor of 110 is deleted from the program.

Another modification that is also useful is to limit the input voltage to pin 3 of IC3. Otherwise, if the signal exceeds the positive limit of the ramp, no signal is generated at pin 11 of the parallel port and the program hangs until the voltage falls. Nonetheless, the circuit seems to work remarkably well and I hope to write additional software for it as time permits.

I confess I don't understand the machine language section of the program, and I still don't understand why line 30, S=&HFC00 generates a 'duplicate definition' error in Quick Basic, but maybe enlightenment will come soon. Thanks to Graham Cattley for a thought-provoking design! (Graham Jackman, [gpj@austin.unimelb.edu.au], North Clayton, Vic.)

I'm sure quite a few projects are used to do all sorts of things other than the purpose they were designed for. And that's great, as it means inventiveness is alive and well.

The comments made by Graham on the safety of the project is in reference to a letter in the October '95 issue, in our Letters to the Editor section. It's worth reading, both for background information and to see why the writer thinks a couple of modifications should be made to the circuit.

The suggested modifications are to wire the electrodes and the supply rails to separate plugs, and to increase the input impedance of the electrodes by adding suitable series resistors.

CDI circuit

Last month I promised to include the circuit of a CDI system sent to me by a contributor. The circuit, shown in Fig.4, is from a 1975 Kawasaki workshop manual. The circuit doesn't include any component values, but it might help Mark Lovell (and others) identify the mystery component in the CDI unit in his Kawasaki bike.

The contributor is John Compton of South Mildura, Vic. Mark Lovell's circuit is in the July and October '95 editions, if you want to try and identify the mystery component in Mark's circuit, by comparing it to that in Fig.4. The two circuits are rather different, but my guess is the mystery component is an SCR. See what you think!

What??

As I still don't have any contributor supplied questions, I'm drawing again from *101 Puzzles in Thought and Logic* by C.R. Wylie Jr. It's a rather similar question to last month's, so if you warmed up on that one, this question should be quite easy:

The personnel officer of an electronics firm, in speaking about three men the company was thinking of hiring said, "We need Brown, and if we need Jones then we need Smith, if and only if we need either Brown or Jones and don't need Smith." Did you get all that? So, if the company actually needs more than one of the men, which ones are they?

Answer to February's What?

Clem is the electronic technician, David is the electrician, and Fred is the plumber. ❖

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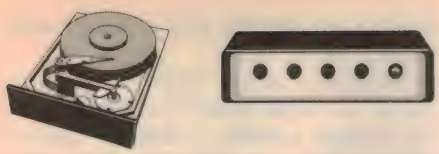

EA'S COMPUTER BBS

As part of its service to readers, *Electronics Australia* operates a Reader Information Service Bulletin Board System (BBS). This provides a wide range of useful information, for convenient access and downloading by readers equipped with a PC and modem.

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FORUM

(Continued from page 41)

will usually work 100% error free to other dedicated machines with similar adjustments, even at 14,400 baud!

Putting it simply, the fax modem devices that are becoming commonplace nowadays are in 70% of the cases, incorrectly adjusted for the phone lines they are connected to, and will not allow for any manual compensation. Not only do the users of these devices suffer poor performance, but innocent operators of dedicated machines have troubles themselves in sending to them and other parties. This is often a result of the typically high signal levels that these fax modem devices emit on usually a relatively low loss line cable, which will cause either crosstalk to adjacent cable pairs within a telephone trunk, create signal echo, or saturate the line termination cards at the telephone exchange.

Most reputable, dedicated fax machine manufacturers will within the purchase price of a machine, go out to install and properly set up the unit's specific communication parameters, according to the type of line the customer is connected to. This may include adjustment of the signal level, slope of the transmitted signal (frequency response), group delay and line impedance (Telecom currently use one of two different line impedances). These adjustments are mainly to overcome the resistive, capacitive and inductive properties in the cable between the user and the exchange. Basically the longer the cable, the more compensation is required in the adjustments to ensure a reliable data signal.

This proactive approach is simply not currently available from the type of devices that were reviewed in Tom Moffat's column. I therefore suggest that the problems he had with one of the devices reviewed was a case of improper mismatch between it and the line.

As for 14,400 baud fax machines, these are now commonplace in Australia and have no problems whatsoever working over the Australian Public Switched Telephone Network (PSTN), provided that the machine has been correctly installed and setup. I suggest again that the failure of the device to establish a 14,400 baud connection with any machine is again in the improper mismatch between the device and the line, and not the absence of a compatible recipient.

The sort of problems that I have referred to are not isolated to the fax modem community either. Data modem buyers should also be aware of similar problems that can be experienced if a particular brand does not allow for any manual compensation.

It is time for the manufacturing industry in Australia to start doing some R&D and stop throwing textbook designs onto the market. It is also time for people to stop blaming the Telecom Network for data communication problems. Agreed, at times Telecom have their faults, but the excuse that the Australian PSTN is just not designed for data or the higher baud rates is simply not true. All baud rates for fax and data are simply a 2400 baud baseband (which has always worked reliably over the 3kHz bandwidth of the PSTN) with some form of data compression/alternative modulation over the top — e.g. PSK, QAM, Trellis. In addition, Australia's phone network is almost entirely digital now, with the only analog paths being between the exchange and the customer's equipment; i.e., the physical line cable, for which we provide the adjustments.

For the time being at least, fax modems will not be a replacement for a proper, dedicated, brand name machine, and I will continue to have a job within the 'dedicated' facsimile industry for a while longer. If not for the fact that a dedicated machine is far better, then for the purpose of troubleshooting the communication problems that are constantly arising from those nasty fax modem devices that my poor innocent customers are attempting to communicate with.

Hmmm — as you can see, our correspondent isn't too impressed with today's fax/data modems. And since he works in the fax machine industry, he's presumably right in his claim that they don't incorporate the same facilities for line level and equalisation, impedance matching and receive sensitivity found on dedicated fax machines. Which might well explain why so many people seem to have reported problems with PC-based fax setups, and perhaps also some of the mysterious problems that many of us have experienced with data communications.

I hope you found his letter as interesting as I did. If nothing else, it's a healthy reminder about the need for fairly flexible line matching and equalisation, if a modem is to provide really reliable performance for either fax or data communications. Those more expensive models really do provide something more than the el-cheapo models, it seems! ❖

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

March 1946

First coloured radio pictures: The first coloured radio pictures from London to Australia have been received in Melbourne. Beam Wireless transmitted it as an experiment. Amalgamated Wireless (A/Asia), Ltd, and Cable and Wireless Ltd, co-operated.

The picture is a colour plate from the international textiles journal showing latest English fashions. No colours were transmitted by radio, but four separate black and white negatives were sent. One was marked red, one yellow, one blue, and one black. Experts regard the experiment as a revolutionary event. They describe the print as almost as good as any coloured photograph processed locally.

Woman engineer's diploma: The second woman in NSW to gain the Diploma of Radio Engineering, Miss Marie Clark studied at night while working in the day on scientific investigations, which have since been recognised abroad.

Miss Clark, who is a Science graduate of Sydney University, has been employed by AWA for the past four and a half years, investigating with three other scientists the effects of tropical conditions on radio apparatus. A report of their findings, sent to America several years ago, was declared far in advance of similar experiments in any other country.

Formerly a school teacher, Miss Clark commenced her diploma course after she joined AWA because the people she worked with 'talked about things unknown to her'.

Magic eye of radar: Specially designed radars, used by the US Army during the war to detect enemy night traffic, had an uncanny faculty of being able to track all moving objects in the area covered by the beam.

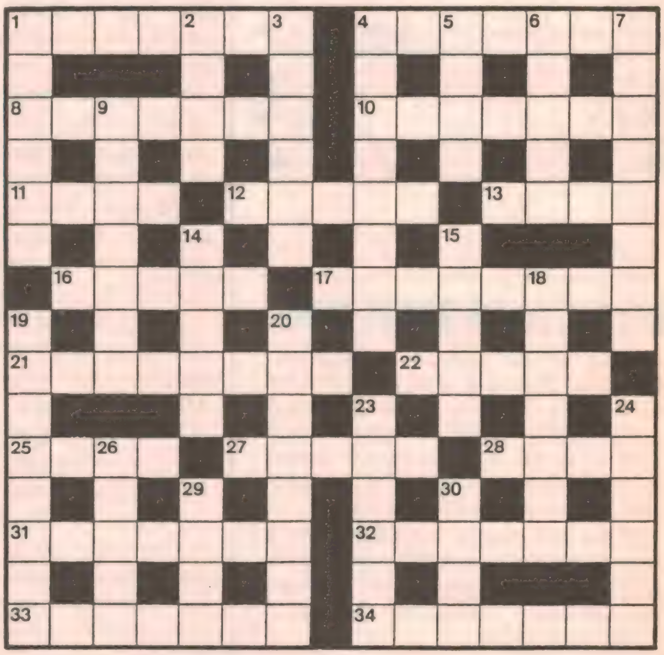
Vehicular targets were detected as far as 16 miles distant, while individual enemy soldiers could be spotted three miles away. This has been disclosed by Major General H.C. Inglis, Chief of the US Army Signal Corps. Through radar detection of artillery and mortar projectiles, enemy gun positions were accurately spotted at ranges of more than five miles.

March 1971

Ship-shore by satellite: Satellite communication with ships at sea has been shown to be technically feasible in recent tests including a series carried out between the UK and the container ship 'Atlantic Causeway', during a voyage between Europe and the USA. Tests were carried out jointly by the British Post Office, shipping and radio operating companies, and suppliers of equipment, with assistance from NASA and the US Coast Guard.

Good quality voice circuits were reliably maintained using relatively simple antennas and equipment over a VHF radio circuit from a PO radio station in Somerset through the ATS-3 satellite made available by NASA. ❖

EA CROSSWORD



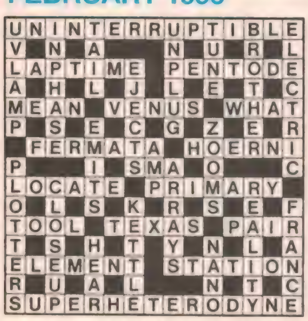
ACROSS

1. Type of publishing. (7)
4. Illuminated from within. (7)
8. Device for frequency selection. (7)
10. Part of a transistor. (7)
11. Mechanism in a movie projector. (4)
12. Microsoft program. (5)
13. Sliding contact for electrified rail. (4)
16. Inactive. (5)
17. Aircraft with blades driven by air force. (8)
21. Send message. (8)
22. First observer of the photoelectric effect. (5)
25. Resonant oscillation. (4)
27. Late Beethoven symphony. (5)
28. Term for quality sound. (2-2)
31. Gradual loss of charge, etc. (7)
32. Anticipate; act beforehand. (3-4)
33. State of readiness. (5-2)
34. Name of effect at metallic junction. (7)

DOWN

1. General arrangement. (6)
2. Colouring of image. (4)
3. Time of cycle. (6)
4. Computer accessory, the ---- box. (8)
5. Winding. (4)
6. Lock circuit in certain state. (5)
7. Activated an appliance. (6,2)
9. Receiver's adjunct. (7)
14. Part of alternator. (5)
15. Watt is its unit. (5)
18. Element, metallic and trivalent. (7)
19. Initiator of response. (8)
20. With limits. (8)
23. Increase output. (4,2)
24. Device that removes certain signals. (6)
26. Production made on stage. (5)
29. Unit of data transmission. (4)
30. First name of first moonwalker . (4)

SOLUTION TO FEBRUARY 1996



Electronics Australia's

Professional Electronics

S • U • P • P • L • E • M • E • N • T

TOSHIBA DEVELOPS 'BOTTLE' MEMORY CELL WHICH SHOULD ALLOW 1-GIGABIT DRAMS!

COMPUTER APPLICATIONS: VIRUS EXPERT TELLS ABOUT TODAY'S *REAL* SECURITY RISKS

WE REVIEW THE NEW H-P SCANJET 4C *FAST* 600DPI FLATBED COLOUR SCANNER, ALSO 'DART' SOFTWARE WHICH CLEANS UP NOISY AUDIO...

NEW SERIES OF HIGH END 'ASYC II' HANDHELD MULTIMETERS FROM METRIX OFFER 50,000-COUNT RESOLUTION, TRUE RMS MEASUREMENTS UP TO A CREST FACTOR OF SIX, SOFTWARE CALIBRATION VIA AN OPTICALLY ISOLATED SERIAL PORT, AND SAFETY MEETING IEC1010-1 CLASS 2. REVIEW INSIDE...

NEWS HIGHLIGHTS

SKANDIA WINS TELSTRA CONTRACT

Melbourne firm Skandia Electronics has won an important Telstra contract to supply field strength meters, used to validate the quality of signals delivered to the set-top boxes of Pay TV customers. It is planned that in due course all of Telstra's Foxtel installation teams will have a calibrated field strength meter for this purpose.

The initial contract required the urgent supply of 300 handheld meters, type APM340, over the first three months of the year. The total potential value of the contract was expected to extend to $2-3 million over the 1996-97 period.

Skandia has been supplying field strength meters to the Australian market for several years, and claims to have been the largest supplier to the emerging Pay TV industry over the last 18 months.

AMATEUR VICTORY CLAIM AT WRC-95

The Wireless Institute of Australia (WIA) is claiming that an important victory for radio amateurs was achieved at the recent World Radio Conference, WRC-95. The WIA's ITU Study Group and Conference Coordinator David Wardlaw VK3ADW was a member of the official Australian delegation to the conference.

Dr Wardlaw reported that at the Conference he successfully lobbied, with the assistance of Wojciech Nietyksza SP5FM of the IARU and the support of the Australian delegation, to have footnote 808 included in the ITU International Frequency Tables. Footnote 808 concerns the amateur satellite service, and indicates the 5830-5850MHz band as a secondary amateur-satellite (space-to-Earth) allocation. An additional footnote, number 915, was also included in the move into the frequency tables; this footnote concerns a secondary amateur allocation at 120GHz.

The WIA comments that although the bands concerned are little used at present, the moves will improve the visibility of the amateur satellite service to regulatory authorities around the world and ensure that the 5830-5850MHz and 119.98-120.02GHz band allocations are

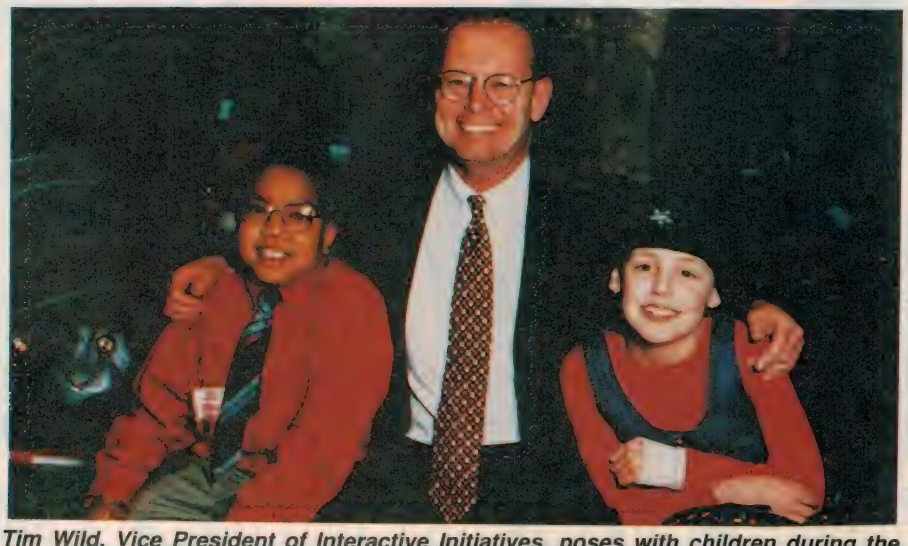
VIRTUAL REALITY FOR ILL CHILDREN

Seriously ill or disabled children in hospitals in the USA are taking part in a pilot that aims to not only ease their pain, loneliness and suffering but also help map the future of ATM technology.

Four USA hospitals are participating in the pilot, linking seriously ill children from their hospital beds into a fully navigable interactive community. They are part of STARBRIGHT World, a ground breaking technological initiative developed by non-stop networking company UB Networks in collaboration with the Starbright Foundation.

Starbright Foundation Chairman Steven Speilberg says "By linking kids who are often deprived of the simple joys of childhood, we give them playspace just like a park or playground in which they can interact with one another unencumbered by their physical limitations. Not only do they get the chance to communicate with their peers, but these distractive interventions have significant therapeutic value."

"These kids will get the opportunity to come out of the isolated and often debilitating world of hospitals, therapy, pain and medicine to play, create, imagine and grow in ways that are not only the privilege but the right of every child," Speilberg said.



Tim Wild, Vice President of Interactive Initiatives, poses with children during the STARBRIGHT celebration.

Children who are too ill to move around can enter STARBRIGHT World through computer terminals set up in hospitals and linked by a high speed network. In twos, threes or larger groups the children can play interactive games, navigate the three dimensional worlds, type messages to each other and talk to each other. They can even communicate face-to-face with another patient through a video conference link.

The virtual playgrounds of these hospitalised children demonstrate the current capability for interactive ATM WAN, 3D communication over existing phone networks.

STARBRIGHT World is the result of a collaboration between US Networks, which supplied the network server and ATM and Ethernet routers and switches; Sprint which supplied the high bandwidth, fibre optic T-3 transmission links to link the STARBRIGHT server with participating hospitals; Intel Corporation, which contributed the PCs outfitted with video conferencing systems; and Worlds Inc (of which UB is a major shareholder), which developed the virtual playgrounds.

not overlooked in the future.

They claim it also sets a precedent, that footnotes regarding the amateur service should be included in the ITU frequency tables.

A proposal by the New Zealand Ministry of Commerce to suppress ITU regulation RR 2735, concerning the requirement for competency in Morse code as an amateur licence qualification for operation below 30MHz, is reported as having met with a 'mixed reaction' in working groups, and was not discussed at formal committee or plenary levels of the Conference.

Instead it is now to be considered for the agenda of the 1999 Conference, to provide a period in which the world's amateur radio community and spectrum administrations can give it 'full consideration'. The WIA describes this delay as a 'four year reprieve' for the Morse code qualification.

SATELLITE & CABLE CONFERENCE, SHOW

The 1996 Pan Asia Satellite and Cable Television Conference and Exhibition is being held at the Hong Kong Convention and Exhibition Centre, on March 26-28. This is the sixth of these annual conventions, which claim to be the premier gathering of the world's satellite and cable TV industries.

This year over 70 expert speakers from around the world (including Frank Anthony, CEO of Australia's Optus Vision) will give their insights into virtually every area of these industries. In-depth sessions will be held on Cable and Telephony, Asian and International Programming, Technology and TV, Marketing and Advertising Strategies, Satellites and DTH in Asia, and Finance and Regulation. There will also be an optional one-day workshop by Wendell Bailey, VP of Science and Technology for the US National Cable Television Association.

Over 600 industry executives attended the 1995 Conference, the largest gathering yet of television decision makers in the Asian area. This year's Conference is expected to be even larger. Further information is available from AIC Conferences, 2/F Universal House, 229-230 Gloucester Road, Wanchai, Hong Kong; phone (852) 2520 1481 or fax (852) 2866 7340.

AEDC COURSE ON SYSTEM EMC

Two new courses are being offered by the Australian Electronics Development Centre (AEDC) this year, both of which are very timely in view of the current emphasis on electromagnetic compatibility and quality/performance considerations.

'Advanced Techniques for System EMC' (SEMC) is being conducted by Professor Gonschorek, a world expert on EMC from the EMI/EMC Institute in Dresden, Germany. This is a two day course and is being offered in Melbourne on March 21-22, Adelaide on March 25-26 and Sydney on March 28-29. This course builds upon the material covered by the existing course 'Electromagnetic Compatibility — Solving the Problem' (EMC2), which is being offered in Melbourne on May 14-15 and Sydney on March 14-15 and May 2-3.

'Performance Measurement' (PMSR) is a quality course that is applicable to all companies. It is designed to teach participants the answers to three main questions: Why measure?, What should we measure? and What should we do with our measurement?

Further details are available from the AEDC at PO Box 323, Broadmeadows 3047; phone (03) 9302 1422, or fax (03) 9302 1201.

At the Productronica Exhibition in Munich, Germany, Heraeus displayed these opaque fused silica crucibles (called 'snowballs'). With a diameter of 813mm and a height of 500mm, they are for growing silicon crystals needed for the next generation of 300mm IC wafers.

NEW TRANSMITTERS FOR STATION VNG

Australia's time and frequency standard radio station VNG, operated by the National Standards Commission, has acquired two additional transmitters to its plant. The acquisition was reported by Dr Richard Brittain, Secretary of the National Time Committee and Manager of Radio VNG, in his annual report.

An STC 4SU55A/S 2kW broadcast transmitter has been acquired from station 2KA in the Blue Mountains (NSW), while an STC 4RSU48B 10kW transmitter was acquired from the National Transmission Authority in Bald Hills, Brisbane Qld.

It is envisaged that the 2kW transmitter will be used to replace the Harris-Gates unit previously used for the 5MHz service, while the 10kW transmitter will hopefully become a standby to minimise outages due to failures and maintenance.

Further information on VNG can be obtained from Dr Brittain at the NSC, PO Box 282, North Ryde 2113; phone (02) 888 3922 or fax (02) 888 3033.

GOVT RECOGNITION ONLY FOR NATA

The Federal Government has announced that the National Association of Testing Authorities (NATA) is to be Australia's only Government recognised national laboratory accreditation authority.

The announcement by Senator Chris Schacht, Federal Minister for Small Business, Customs and Construction, confirms NATA as the only Australian agency empowered to accredit a laboratory for technical competence to carry out specified tests. This accreditation is crucial to testing and quality control within Australian industry and within our export markets.

NATA provides the only Australian laboratory testing program to examine all the technical components of a laboratory's operations, in line with ISO Guide 25 and other criteria established by NATA and now recognised internationally.

The Federal announcement also confirmed NATA's international role, and that NATA will continue to represent Australia at overseas laboratory accreditation forums and at international conferences. As well, the Federal Government intends to discourage other assessment bodies from offering programs claiming to be equivalent to NATA accreditation or to offer similar benefits.

"These are important decisions for Australia because they give NATA a clear national mandate to set standards for Australian laboratory practice, for all areas of testing and measurement," said NATA Chief Executive Mr John Gilmour.

"They will be welcomed not only by the nearly 2500 laboratories which have accreditation by NATA, but also by the huge range of industries which they serve."

S-A, SIEMENS TRIAL CABLE TELEPHONY

Electrabel, Belgium's largest power company and CATV technical partner of the IVEKA cable franchise, has completed the first part of a multiphase trial of CoAxiom cable telephony technology.

The CoAxiom system is being developed jointly by Scientific-Atlanta, Inc. and Siemens Public Communication Networks Group. CoAxiom was successfully demonstrated with calls over the IVEKA CATV network in the city of Geel, Belgium. Six telephone sets (both wireless and regular phones) were connected via the CATV network to a central unit located at the Geel city hall.

A 16km (10 miles) branch of the existing Geel network was used, with 32 trunk and distribution amplifiers in cascade and upgraded and 5 - 25MHz reverse transmission capability. This reverse band was used to transmit modern ISDN-like digital 64kb/s telephony signals from telephone users to the central unit. Only a small fraction of the 300 - 450MHz band was used to transmit signals from the central unit to telephone users.

No normal telephone wires (twisted pair) were used in the trial. Results of this trial confirm that the existing CATV infrastructure in Belgium will support telephony services by upgrading the reverse path and network powering.

In Australia, Optus Vision is building a more advanced 750MHz CATV infrastructure. Optus Vision plans to use a reverse transmission band of 5 - 65MHz for telephony services.

The demonstration of the CoAxion system was the first phase of a collaborative trial between Scientific-Atlanta, Siemens Belgium, Siemens Atea, Electrabel and IVEKA in providing telephony services via Belgium's cable network.

Full network trials are planned for 1996 with deployment in 1997 and commencement of service scheduled to begin in January 1998, according to current European Union local telephone deregulation rules. By comparison, Optus Vision plans to commence cable telephony services in mid 1996.

PHILIPS INVESTS $700M IN AUSTRALIAN IT&T

Philips Electronics has joined the Federal Government's Partnership for Development program with a $700 million investment strategy designed to boost Australia's information technology and telecommunications industries.

The seven year partnership will involve Philips in design and development, strategic investment, technology transfer and export initiatives in collaboration with Australian owned companies.

It will focus on core business and technology — intensive activities including public telecommunications systems, broadband transmission systems, rural microwave systems, intelligent traffic systems, engineering systems, multimedia, microelectronic components, and industrial design.

Philips aims to generate $713 million in new business activity through the partnership strategy. The plan forecasts the delivery of:

- Total D&D investments of $95 million. D&D investment rises from 4.5% of IT&T sales to 7.9% during the course of the seven year business plan;
- Exports of Philips' products, systems and services of $364 million with a forecast Australian value added of $249 million over the term of the plan and 72% value added in year seven;
- Exports facilitated by Philips of $254 million.

Philips Electronics Chairman and CEO, Justus Veeneklaas, described the partnership plan as a "tremendous vote of confidence in Australia's future".

Federal Minister for Industry, Senator Peter Cook, and Philips Electronics chairman, Justus Veeneklaas, toast the company's $713 million boost under its Partnership for Development agreement with the Australian government.

117 SUNS TO RENDER TOY MOVIE

The making of *Toy Story*, the stunning new movie from Walt Disney Pictures that is the world's first full length completely computer generated animated film, involved the use of more than 100 high powered computers from Sun Microsystems — which together comprised one of the most powerful graphics rendering engines ever created.

Pixar Animation Studios of Point Richmond, California, the pioneering digital animation studio that produced

Toy Story for Disney, selected the Sun systems for their affordability and expandability, as well as for their high quality graphics rendering abilities.

For the movie, Pixar created a networked bank or 'cluster' of 117 Sun SPARCstation 20 workstations — each containing at least two microprocessors, and running on Sun's Solaris operating environment — to handle the critical task of 'rendering' each of the 114,000 frames in the 77 minute movie. Rendering is the time and computationally intensive process in which the correct lighting, textures and shading are applied to 3D computer models to produce sharp, colourful images with photorealistic detail.

To render the startlingly lifelike images in *Toy Story*, Pixar used its own Academy Award winning RenderMan software running on its cluster of networked Sun systems, which was dubbed the 'RenderFarm'.

The use of multi-processor; high speed networked Sun technology answered one of Pixar's key requirements for *Toy Story*; an unprecedented amount of sheer computing power. While more films are using digital effects, from *Jurassic Park* to *Forrest Gump*, *Toy Story* is the first entirely computer based animated film, which required a tremendous amount of rendering performance.

Until now, the cost of rendering technology to produce a full length film has been prohibitive, but Sun's cost effective, scalable multi-processor technology promises to revamp the industry by providing these capabilities in a high speed networked environment using standard systems.

RenderFarm is one of the most powerful rendering engines ever assembled, comprising 87 dual processor and 30 four processor SPARCstation 20s and an eight processor SPARCserver 1000.

The RenderFarm has the aggregate performance of 16 billion instructions per second — its total of 300 processors represents the equivalent of approximately 300 Cray 1 supercomputers.

Each system is the size of a pizza box, and all 117 systems work in a footprint measuring just 19 inches deep by 14 feet long by eight feet high.

BMW's new 5-series cars feature a new Auto Scout car navigation system from Siemens. A console unit mounted on the dashboard (visible at right) pilots the driver via both on screen maps and acoustic clues. The required road maps and city plans are provided on diskette and are already available for many European countries and the USA.

TOSHIBA DEVELOPS 1GIGABIT CELL

Researchers at Toshiba Corporation's ULSI Research Labs in Tokyo, Japan, have announced development of a new memory cell with an innovative trench capacitor structure. The cell brings closer the achievement of highly compact designs for future generations of dynamic random access memory (DRAM) with a capacity of one gigabit and more, and promises lower manufacturing costs than other memory cells.

The researchers have succeeded in using the new design to fabricate a memory cell with an area of 0.228 square microns, approximately 75% the size of the smallest cell yet reported.

A DRAM memory cell consists of two fundamental components, a capacitor and transistor. The trench capacitor of Toshiba's new cell has a unique bottle shaped structure.

Reductions in cell size by use of ever finer sub-micron processing technologies results in a narrower capacitor. Maintaining sufficient capacitance to hold electrons (data) requires a compensatory deepening of the capacitor, but manufacturing a sufficiently narrow and deep structure has proved difficult. Toshiba has overcome the problem with the bottle shaped design, which is narrow at the neck but wider in the area which holds the electrons. This innovative structure can be fabricated with only simple modifications to current processing technology.

Employing the newly developed technology and processing technology for conventional trench capacitors — without the need for any new processes — researchers established that the bottle shaped capacitor achieved a capacitance 1.3 to 1.5 times that of conventional trench capacitors with the same depth.

The trench capacitors of typical memories have a collar oxide layer fabricated on the sidewall of the capacitor opening to prevent electron leakage. Toshiba researchers used this basic design for the new capacitor.

During an extended chemical dry etching process, the collar oxide layer prevents the etching of the capacitor's sidewall at the neck, while the area below the neck is enlarged, thus creating the bottle shaped cross section. While the researchers had to modify the manufacturing sequence, they were able to use conventional processes, with no increase in their number.

The design also required changes in some of the materials used in the fabrication process. ❖

NEWS BRIEFS

- Comlinear Corporation has become a business unit within the Analog Products Division of ***National Semiconductor***.
- Anthony Pitt has been appointed Internal Sales Manager at ***Amtex Electronics***.
- The 28th ***Australian International Engineering Exhibition (AIEE'96)*** will be held at Sydney's Darling Harbour Exhibition Centre, May 28-31 1996. For details phone (02) 699 2411.
- ***Stanilite Pacific*** has appointed Bryan Sue San as Chief Executive Officer of its newly formed Telecommunications Division.

NEW PRODUCTS

Passive component tester

According to Philips Scientific & Industrial, Fluke's new PM6306 RCL meter offers sophisticated, user friendly capabilities for passive component testing. To operate it, the user connects a component to the tester and its large LCD provides an instant read-out of dominant and secondary values, as well as the equivalent circuit diagram.

The meter's test frequencies are continuously variable from 50Hz to 1MHz, to suit testing requirements for products such as switched mode power supplies, or low value capacitors and inductors.

The instrument also features continuously variable AC/DC voltage scales, so you can analyse the frequency or voltage behaviour of a component. If required, a DC bias of up to 40V can be added to test components such as electrolytic capacitors and semiconductor junctions.

Test convenience is enhanced by the new 'deviation mode', for component comparison. It gives an instant percentage read-out of the difference between the initial measurement and a reference value.

The test can also be part of a fully automated component testing environment, with the ability to handle up to 10 measurements per second when connected to a PC via an IEEE-488 interface.

Other features include a component binning function. Based on pre-programmed tolerance limits, components can be sorted into as many as ten bins. The operator inserts the component in the test fixture, and reads the indicated bin number from the display.

For further information circle 235 on the reader service coupon or contact Philips Scientific & Industrial, 34 Waterloo Road, North Ryde 2113; (02) 888 8222.

Seismic accelerator has 1μG resolution

PCB Piezotronics has introduced the 393B31 seismic accelerometer for continuous measurement of low level, low frequency vibration of buildings, bridges and other large structures. The unique 'flex-tensional' sensing design, coupled with ultra-quiet built-in electronics, gives a broadband resolution of 1μG, while minimising the effect of thermal transients.

The sensor has a 10V/G output and responds accurately from 0.2 to 200Hz

Signal recorder has four analog channels

The Hioki 8853 Memory HiCORDER has four plug in analog channels which can be simultaneously recorded together with sixteen logic channels. The recorder provides real time recording capacity in excess of 123 days and memory recording for more than 45 hours.

Signal isolation of 450V AC or DC between channels, or between channels and frame, make the instrument well suited to tasks such as adjustment and inspection of electrical plant, testing inverters and converters as well as monitoring sensors with common mode voltages, such as thermocouples and accelerometers.

A thermal printer (110mm width x 30 metre) and 178mm raster scan CRT with three grey scales are provided. Analog channels have 10MS/sec converters, 12 bit resolution and a bandwidth of 4MHz. Triggering modes include glitch, level, level with time-out and window, event (with a specified number of trigger crossings).

A wide range of mathematical computations can be performed on up to four channels simultaneously. Two groups of eight logic channels, each of which can be set to a specified triggering pattern, can be ANDed or ORed, making the instrument suitable for timing analysis of digital circuits.

The recorder has a memory capacity of two megawords, or 500 kilowords per channel. In addition to the standard floppy drive in the instrument, mass storage such as 230MB and 128MB magneto-optical and hard disks are available as options.

For further information circle 231 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone 1800 623 350.

(+/-5%), making it suitable for seismic anomaly detection. The case isolated design protects the sensor from ground loops and other environmental noise, and the rugged 2-pin military style connector ensures reliable connections in harsh environments. It can be used directly with FFT analysers, vibration meters and data collectors that provide constant current ICP excitation.

For further information circle 232 on the reader service coupon or contact M.B. & K.J. Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277.

Programmable impedance tester

The Hioki 3531 impedance tester is suitable for a variety of tasks including measurement of frequency dependence of coils, transformers, solenoids, motors and magnetic heads as well as other components such as capacitors and batteries.

The instrument measures impedance (Z), admittance, phase angle (θ), resistance, conductance, reactance, susceptance, inductance, capacitance, dissipation factor (D = 1/tan θ) and quality factor (Q = tan θ). These parameters can be measured in the frequency range of 42Hz to 5MHz in steps variable from 0.1Hz to 1kHz. A constant voltage, variable from 10mV to 5V and a constant current, variable from 10uA to 100mA provide excitation of the device under test.

The instrument has a touch sensitive screen for programming purposes, including setting comparator values in production control. The comparator can operate on two parameters, eg Z and θ, simultaneously. A function to save five different panel setups facilitates rapid switching for measuring a sample under different conditions. A GPIB interface is fitted as standard and an RS232 interface is optional.

For further information circle 233 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone 1800 623 350.

High gain, 1550nm fibre optic amplifier

Mitsubishi Electric has announced the FG-602S-TO1 erbium doped fibre amplifier, which provides single mode direct amplification for optical fibre signals for 1550nm window applications. The amplifier is optimally designed to provide a flat gain, particularly over 1535 to 1565nm and features alarm signal monitoring and automatic shutdown when transmissions cease. Notably, the amplifier will amplify all channels operating in the window and is designed to accommodate simultaneously a high number of channels with very high data rates. The unit can amplify 60Gbits/s in a single pass.

The amplifier design comprises an erbium doped fibre optic coil to provide the gain, with the optical signals pumped by 1480nm isolated laser diodes. Full temperature control for the pump lasers is electronically controlled within the amplifier housing and fibre optic couplers combine the pumped signals into the doped optical fibre. The control circuitry generates TTL signals for pump bias and temperature alarms as well as for pump shutdown.

The amplifier is supplied in a compact, static safe casing measuring 152 x 122 x 25mm, with heat sink mounting facilities and interface and monitor connector sockets.

Minimum large signal inputs of -5.5dBm power are amplified to at least 15dBm. Small signal input power is -30dBm and gain is a minimum 28dBm, with a typical noise figure of 6dB. Typical supply operation is from +4.75 to +5.25V at 3A for the positive supply and -5.46 to -4.94V at -3.6A for the negative supply.

For further information circle 237 on the reader service coupon or contact the Semiconductor department at Mitsubishi Electric Australia on (02) 684 7777. ❖

Product Review:

METRIX MX56 HANDHELD DMM

Respected European test instrument maker Metrix has recently released a new series of high-end handheld digital multimeters, the ASYC II Series, offering significantly improved performance as well as a very high order of safety and reliability. Here we look in particular at the new top of the range model, the MX56.

by JIM ROWE

There are four models in the new Metrix ASYC II range, the MX53 — MX56, offering different combinations of performance and measurement flexibility. However the four models also have many important features in common, including a very rugged case meeting IEC1010-1 class 2 safety specs, an impressive 50,000 count measurement resolution, true RMS measurements (both AC and AC+DC) with a maximum crest factor of six, and the options of interfacing the instrument with a PC for either data logging or digital/software calibration, via an inbuilt optically isolated serial interface.

The MX53 'base' model offers a rated basic accuracy of 0.1%, a bandwidth of 30kHz and an accuracy on the 50mA current range of 0.2%. This model provides most of the main measurement facilities of the series as a whole, with five DC voltage ranges (500mV, 5V, 50V, 500V and 1000V full scale); five AC/AC+DC ranges (500mV, 5V, 50V, 500V and 750V FS); four DC and AC/AC+DC current ranges (5mA, 50mA, 500mA and 10A FS); six resistance ranges (500Ω, 5kΩ, 50kΩ, 500kΩ, 5MΩ and 50MΩ FS); seven capacitance ranges (50nF, 500nF, 5uF, 50uF, 500uF, 5mF and 50mF FS); continuity and diode testing; the ability to measure frequency and positive/negative duty cycle, register positive/negative peaks, and hold readings.

Incidentally the input resistance of all four models on the 500mV ranges for both DC and AC/AC+DC can be set for either 10MΩ or 1GΩ, as desired. It is fixed at 11MΩ on the 5V ranges, and at 10MΩ on the higher ranges. The rated input capacitance on all ranges is 100pF.

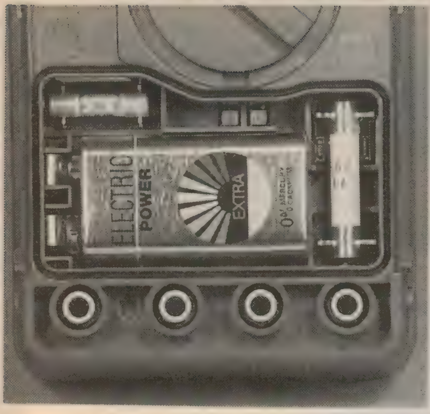
The MX53 also establishes the ruggedness, safety and overload protection performance for the series. The ruggedness meets international standards IP 677 and MIL-T-28800, for example, while in terms of safety the meters all meet IEC1010-1 class 2 (degree of pollution 2, 600V CAT III and 1000V CAT II). The overload protection is also very impressive, with the meters able to withstand 1100V continuously or 6kV for up to 10us on all voltage ranges via MOV protection, and up to 600V on all current ranges via fuses. All other ranges are also protected to 600V AC or DC.

Of course EMC rating is now of great interest in both Australia and many other countries, and here again the MX53 sets the standard for all of the new models. In terms of emission levels they all meet EN 55011 class B, while their susceptibility meets IEC 801, level 3.

With the MX54 the basic and 50mA accuracies both improve to 0.05% (the accuracy also improves on most other ranges), while the bandwidth increases to 100kHz and various extra features are added — including min/max/average calculation, a mains disturbance indication facility, temperature measurement to 800°C with an accuracy of 1°(via a matching platinum-sensor probe), and the ability to read AC voltages in dB, with a resolution of 0.01dB and the ability to set the impedance level to any value between 1Ω and 9999Ω.

As well as the additional bandwidth for true RMS measurements, the MX54 and higher models also provide an additional current range, with a full scale sensitivity of 500uA and a resolution of 10nA.

For the MX55 the basic accuracy improves to 0.025%, with most of the other features remaining the same as the MX54, except that this model lacks the



The battery and fuses for the ASYC II series of meters are housed in a separate compartment, behind the front panel.

min/max/avg facility, mains disturbance indication and temperature measurement range.

At the top of the range the MX56 offers almost all of the features of the other models, plus a few more again. The basic accuracy is now 0.025%, with a bandwidth of 100kHz and a 50mA accuracy of 0.05%; you also get min/max/avg, mains disturbance indication and dB measurement, although not temperature. There's now also the ability to make resistive power measurements, in either watts or dB; the ability to measure positive and negative pulse width, and to perform event counting.

The readout on all four models is via a high contrast LCD panel, with main digits 14mm high and a 34-segment 'bar graph' analog display strip along the lower edge. Legends for the current range and measurement mode are along the top, with the measurement units and multipliers on the right-hand end and various secondary indications between the main digits and the analog display. The main digital display is updated twice per second, while the analog bar graph is updated 20 times per second.

An elegant feature of all four models is that in the event of a protective fuse blowing, the meter gives a clear diagnostic message on the display — such as 'FUSE 1'. A similar message warns of high voltage levels, while an audible 'beep' is emitted in the event of an overrange condition (and also for continuity checking).

Another important feature is the innovative design of the rugged case used for all models. Along with the fuses, the 9V battery which powers the meter is housed in a separate compartment, access to which can be achieved without disturbing the main case seal and prejudicing the instrument's safety or calibration. This also effectively removes any risk of damage to the meter 'works' due to contamination from leaking batteries or whatever...

The battery/fuse compartment is in fact just behind the dress front panel, which although firmly attached actually unclips quite easily once you have unclipped the Metrix patented 'SECUR-X' test lead plug retainer strip, along the bottom. Then with the dress front panel removed, you have access to a small sealing gasket; when this is lifted off in turn, you have easy access to the battery and fuses — plus the optical transmitter and receiver for the instrument's isolated RS-232C port.

All four meters allow the use of optional matching isolated RS-232C connector cables, for either data logging with a PC, or digital meter calibration via dedicated software.

All four meters in the Metrix ASYC II range measure 189 x 82 x 40mm, and weigh 400 grams. They also feature automatic power turn-off after 30 minutes of inactivity, giving a rated life of 500 hours for the 9V battery.

Trying out the MX56

Thanks to Metrix distributor Nilsen Technologies, we were able to try out an early sample of the new MX56 flagship model for a couple of weeks. Compared with our reference instruments in basic tests of resolution and accuracy, it gave a very good account of itself — giving every evidence of being well within rated specs, in fact.

For example the basic DC voltage accuracy was within 0.01% of our recently calibrated Yokogawa 7562, on all ranges we checked. Similarly the AC voltage accuracy was within 0.1%, and the resistance accuracy within 0.05% on all ranges checked.

As well as performing these checks we also used the meter on the bench for a while, to make a fairly wide range of typical DMM measurements. It turned out to be convenient to use and consistently quite unambiguous in its readings — in short, delivering just the level of performance you'd expect from a meter of its class.

Although we didn't try dropping it onto a concrete floor to check ruggedness and reliability, nevertheless we gained the impression that these characteristics were at least as high as any other DMM we've ever seen or used.

The optically isolated RS-232C interface kit for linking the MX56 to a PC wasn't available at the time of our testing, so we weren't able to try this out. However for interest's sake we did remove the instrument front panel and examine the battery/fuse/interface compartment, as seen in the photo. This aspect of the instrument's design seems particularly elegant, and should ensure that most users will never need to open the main section of the case.

Overall, we were impressed not only with the performance of the MX56, but also with its innovative construction and ease of operation. Judging from this 'flagship' model of the new ASYC II range, then, Metrix's new instruments certainly seem to qualify for inclusion in the top ranks of world DMMs.

The quoted prices for the ASYC II family, which include protective holsters, are $470 for the MX53, $520 for the MX54, $560 for the MX55 and $645 for the MX56. The optional isolated RS-232C interface kit for data logging is $100, while that for instrument calibration is $300.

Further information is available from Metrix distributor Nilsen Technologies, of 150 Oxford Street, Collingwood 3066; phone 1800 623 350, or fax 1800 067 263. ❖

Silicon Valley NEWSLETTER

Smaller CES shows DVD players

At a much smaller 1996 Winter Consumer Electronics Show in Las Vegas, digital video disc (DVD) technology was getting the overwhelming attention. But only two months after the two rival DVD groups agreed on a universal standard that will avert a new 'Beta-vs-VHS' confrontation, DVD players were only represented in slick booth demo versions. Consumers will have to wait until late 1996 before they will see any of the machines on store shelves.

This year's show was considerably smaller than in past years due to the loss of Sega and Nintendo, along with almost all the developers of video game software. The video game industry is by-passing the CES shows in Las Vegas and Chicago in favour of a hot new show called the Electronic Entertainment Expo (E3), which is held every May in Los Angeles. The loss of the video game sector sent attendances tumbling, from 103,000 last year to just 80,000. And at 1800, there were 200 fewer exhibitors than a year ago.

Still, CES remains the premier event for companies to showcase all the latest gadgets in consumer electronics. Items on show included automobile security systems triggered by the sound of your voice, night vision visors for consumers and devices for connecting a camcorder in one room to a TV set in another room, through telephone lines. The mood at CES was relatively optimistic, following healthy growth in most sectors of the US consumer electronics market — which grew 10% in 1995 to an industry record of US$62 billion. The boom in home office and home theatre were two major contributors.

Seattle-based Virtual i-O has introduced a new virtual reality headset for the home and office. Virtual i-glasses create an immersive environment for playing computer and video games with 3-D and head tracking capabilities. The product also connects with TVs and VCRs to provide a personal big screen theatre for private viewing.

According to Gary Shapiro, president of the Consumer Electronics Manufacturers Association (CEMA), industry sales will continue to grow in 1996 fueled by the introduction of new digital products such as DVDs.

"We expect the introduction of the digital video disc (DVD) and the expansion of digital satellite systems (DSS), combined with the continuing home office phenomenon, to accelerate sales to 8% growth in 1996", said Shapiro during the opening session of the CES show.

In 1995, home office products raked in sales of US$22 billion, up 24% from 1994 due to the fact that an estimated 54% of American households set aside space for a home office. In 1996, sales in this category are expected to reach US$25 billion. Personal computer sales totalled 8.4 million units, up 25% from 1994.

Despite the lack of retail-ready machines, DVDs emerged from CES as the likely next huge consumer electronics market. The first wave of DVDs will be limited to movie players that will retail at around US$500. Although they will not make VCRs obsolete until they offer both play and record capabilities (around the turn of the century), they are likely to become the preferred way of viewing movies in the home.

Among the companies that showed off their prototype DVD systems at CES were Pioneer, Sony, Thomson and Toshiba. Sony, which 15 years ago introduced the compact audio disc, showed a DVD disc that stored up to 8.5GB of data, enough to play more than four hours of MPEG-2 video with picture quality that approaches the original D-1 studio master. The discs replace more than a dozen of today's 650 megabyte CD-ROM discs.

"Digital is the language of the convergence of consumer electronics and computers", said Yuki Nozoe, senior vice president of Sony Electronics' Consumer Products Group. "And Sony intends to extend that language as far as possible to all of our product lines."

Another potentially huge new consumer electronics market is that of flat panel displays. New process and manufacturing technologies, most of them borrowed from the semiconductor industry, are about to realise a 30-year-old vision of large size displays that hang on a wall like a painting.

Sony showed off its Plasmatron technology, which produces a high resolution, high contrast, large screen active-matrix flat panel display using plasma addressed liquid crystal (PALC) technology jointly developed with Tektronix. Sony said it will be able to achieve high production yield of Plasmatrons ranging from 20" to 50" displays.

Here are a few more of the scores of new product announcements made at CES:

- By this US summer, consumers will be able to purchase their own nightvision scope. From observing

nocturnal wildlife on a weekend camping trip, to discovering whether the noise in their backyard at night is a burglar or just a pesky raccoon, the new Night Quest line of night vision viewers by ITT Night Vision will give consumers the power to see in near total darkness. The Night Quest line includes the Night Quest 100, a top-of-the-line G2 (Generation 2) night vision viewer that easily slips into a purse or a glove compartment. The Night Quest weighs in at a scant 10oz. and will retail for less than US$800.

- Terk Technologies of Plainview, New York, introduced the 'Terk Home Network', a system for moving television signals through phone lines. For about US$200 to $300, buyers will get a receiver and a transmitter. A camcorder focused on a baby's crib, for example, could be plugged into the transmitter box, which is then hooked to a phone jack. The receiver box, also connected to a phone jack, is plugged into a television set in the family room. Parents can then monitor their baby during the commercials on *Melrose Place*. The devices don't interfere with phone service, and will operate even during phone calls.
- Franklin Electronic Publishers of Burlington, New Jersey, showed a prototype of what could be the world's cheapest personal digital assistant or PDA. Franklin's Bookman, which looks somewhat like a large hand-held calculator and sells for under US$150, is being married to Sidekick, the personal information manager from Starfish Software of Scotts Valley — the company run by former Borland International chief Philippe Kahn. The Sidekick Bookman should be available by June, and will connect with a Windows computer for moving information back and forth.
- Sensory Circuits of San Jose launched the 'Voice Password' microprocessor. The US$4 chip will recognise a pre-programmed password and the voice of it's owner, so interlopers won't get past the chip even if they know the password. Sensory Circuits said several manufacturers of automobile anti-theft systems will build Voice Password chips into their remote access devices.

Samsung sues TI over chip patents

Samsung Electronics has filed a patent infringement lawsuit against Texas Instruments in the US District Court in Dallas, Texas, alleging infringement on 13 US patents.

Analysts said the move represents a tactical move by Samsung, which has been frustrated in its efforts to negotiate a renewal of a semiconductor patent licensing agreement between the two companies. The previous agreement expired on December 31, 1995. The two companies had been negotiating the terms of a new licence agreement for nearly one year.

In addition to its own patent infringement allegations, Samsung also requested a declaration from the court that the patents owned by Texas Instruments are not infringed by Samsung and are invalid and unenforceable.

"Samsung's uncompromising policy is to honour the valid patents of others, and it expects others to respect its patent rights", said Charles Donohoe, vice president of Samsung Electronics.

"Samsung has licensed its patents to nearly all of the major US, Japanese and European semiconductor manufacturing companies. To date, however, Texas Instruments has refused to recognise the value of Samsung's patent portfolio, its contribution to the advancement of semiconductor products, and Samsung's investment in research and development."

Intel & AMD settle last case

Intel and Advanced Micro Devices have finally put to rest the last of the legal cases that spun off from their eight-year courtroom battle. The two companies agreed to grant each other access licences to patents on each other's microprocessor chips for the next five years.

The agreement means consumers will be assured a continued supply of x86-based microprocessors from at least two sources, as the agreement will allow AMD to create its own versions of Intel's x86 architecture chips, to run the same software.

The new agreement extends the sharing of patents between the two companies for five more years and requires them to pay royalties to each other. But it does not mean that the companies are sharing their most crucial chip designs with each other.

"What this means is that AMD can continue to develop its own 'x86' microprocessors without infringing on Intel patents", said Linley Gwennap, editor of the *Microprocessor Report*. "That's good news for AMD."

Chuck Mulloy, spokesman for AMD, said that under the new agreement, there are no obstacles that prevent AMD's chips from running Microsoft Corp.'s standard Windows software.

"We get access to Intel intellectual property, but we still have to build the parts and make the designs, This makes sure there is one software standard going forward."

However AMD still doesn't have a licence for the multiprocessing data pathway bus for Intel's newest Pentium Pro microprocessor. To do a similar chip, AMD would have to create its own methods for getting data into and out of the microprocessor.

MIPS launches faster graphics engine

In a move to give workstation computer users more graphics computing power at a low cost, and keeping Intel from invading the workstations market, MIPS Technologies of Mountain View has released a new microprocessor that brings better three-dimensional graphics processing to lower-priced workstations.

MIPS claims its R5000 chip is 2.3 times faster than Intel's fastest 200MHz Pentium Pro chip in performing some of the maths-intensive calculations needed to create graphics. The Pentium Pro, however, is faster than the MIPS chip at integer calculations.

Ron Bernal, president of MIPS, said the 64-bit chip is MIPS' answer to the low-cost Pentium Pro machines that Santa Clara-based Intel began shipping in November and which Intel hopes will enable it to become a player in the workstation market.

Bernal thinks the MIPS chip will appeal particularly to people who want to access 3D images quickly on the graphics portion of the Internet known as the World Wide Web.

The MIPS chip will run on machines that run Unix or Windows NT operating systems. It will be manufactured by Integrated Device Technology, NEC, and NKK. The 200MHz chip will be available this quarter and will be followed later in the year by a 250MHz version. ❖

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

TV ghost cancelling IC

A pre-processor for ghost cancellation applications in televisions, set-top boxes and VCRs has been introduced by Mitsubishi.

The new device, together with an adaptive filter chip (OR43100) from Oren Semiconductor and a standard 8 or 9-bit video A-D converter, provides the first fully compliant chipset for the FCC GCR (ghost cancellation reference) signal and is adaptable for all emerging NTSC and PAL ghost cancellation standards.

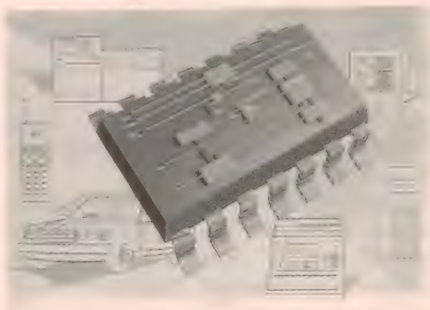
"Television signal deflections from buildings, mountains and other objects often cause images (or ghosts) as well as colour reduction, loss of detail and smeared pictures," said Phil Newton, Mitsubishi Electric Australia's Senior Manager, Semiconductor Department. "Ghost cancellation technology makes it possible for TV ghosts to be cancelled dynamically if the broadcasting station transmits a ghost cancellation reference signal and the TV receiver has a ghost canceller."

Mitsubishi's new M52661SP ghost cancellation mixed signal interface IC provides 'de-ghosted' analog signals to a television display. The device contains a 4fsc burst-lock clock generating circuit, a synchronous separating circuit, a clamping circuit for digital signal processing, an analog video switch and a 10-bit D-A converter. It also features a timebase error detector circuit to detect channel change or VCR signal.

The device is offered in a 52-pin shrink DIP package.

For further information circle 252 on the reader service coupon or contact Mitsubishi, 348 Victoria Road, Rydalmere 2115; phone (02) 898 0484.

Watchdog IC has sleep mode



Combining battery switch over, voltage monitoring and software monitoring in a 14-lead package, the V6175 watchdog IC from EM Microelectronic-Marin is designed for use in security systems and battery powered products.

Using the battery switch over sensor output and the sleep mode input, the IC can be applied as a microprocessor reset. It has a current consumption of 25uA in standby mode, and about 1uA in sleep mode.

The supply voltage is independent of the battery switch over voltage. It can be connected to the output of the switch over circuit or to a third voltage source.

A reset guaranteed down to 1.2V, a precise voltage reference of 1.275V +/-1.2%, an ultra low current consumption, an extremely wide and stable frequency range, and an extended temperature range of -40° to +125°C, make this watchdog IC suitable for a wide range of applications.

For further information circle 253 on the reader service coupon or contact Dice Technologies, 13-15 Chandler Road, Boronia 3155; phone (03) 761 1031.

Low noise UHF amplifiers

MITEQ of the US has introduced the JS series of amplifiers which are claimed to represent the lowest noise

LVDS devices for host LCD interfacing

National Semiconductor has released the DS90CR561/2 and DS90CR581/2 host-to-LCD interface devices. The driver and receiver ICs are claimed as the first LCD interfacing devices to comply with the LVDS low voltage differential signalling standard, and offer a practical way to upgrade laptop computers to XGA screen resolutions. The interfaces are also fully compatible with VGA and SVGA displays.

The devices overcome three barriers that have made it impractical for laptop and notebook computer manufacturers to upgrade to higher screen resolutions. First, increasing resolution pushes up the bandwidth on the interface between the computer and the LCD screen by the square of the number of pixels. Second, the resulting higher clock rates generate more electromagnetic interference (EMI). Finally, the higher addressability requirements lead to wider cable/connector interfaces which are impractical.

To solve these problems, the new interface devices use a combination of LVDS signalling and a clock-splitting technique that allows data serialisation. As a result, the interface to a 1024 x 768 XGA LCD with eight bit colour requires only 20 lines (instead of the customary 52) to achieve the necessary bandwidth, yet keeps EMI to much lower levels than is possible using conventional TTL or low voltage TTL interfaces. Two pairs of the 40MHz LVDS chips are used to implement the 65MHz XGA interface. The devices support all types of LCD based products, including PDAs and telecommunications equipment, as well as PCs.

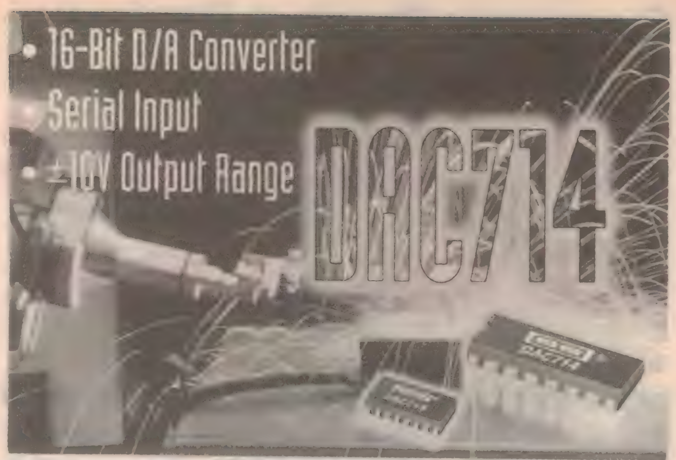
For further information circle 251 on the reader service coupon or contact National Semiconductor, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 558 9999.

16-DAC with serial data interface

Burr-Brown's new DAC714 is a 16-bit monolithic digital to analog converter with internal reference and programmable output. Operating with +/-12V supplies, the converter can support 10MHz input data rates and serial data output for cascaded serial bus connections. It is ideal for precision, industrial applications such as motor controllers, robotics, and in process control output systems.

The IC contains a precision +10V temperature compensated voltage reference, a full scale output of +/-10V, an output current of 5mA, and a fast (50ns) minimum write pulse width. Gain and bipolar offset adjustments can be set internally with potentiometers, or externally using D/A converters.

The specifications include +/-10V, +/-5V, 0 to +10V voltage output, 120nV/√Hz low noise including reference, and is specified over the -40°C to +85° temperature range. It is available in 16-pin plastic 0.3" DIP and 16-lead wide body plastic SOIC packages, and is available from stock.



For further information circle 257 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.

figures in the octave, multi-octave and ultra-wide bands.

In the octave band, the JS models range in frequencies from 0.5 to 1GHz and 26 to 40GHz. Their gains are between 11dB min and 35dB min and noise outputs of 0.35 to 2.5dB max.

Multi-octave bands range in frequencies of 0.5 to 2.0GHz and 18 to 40GHz. Gains are between 0.5 and 3dB max, with noise outputs of 0.5 and 5.5dB max.

Ultra-wide bands in the JS series cover frequencies of 0.1 - 2GHz to 0.5 - 40GHz. Gains range from 1.4 to 3.4dB.

For further information circle 254 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999.

MOSFET driver has 1uA off-state current

Micrel Semiconductor has introduced the MIC5018 IttyBitty high side MOSFET driver IC packaged in a 4-lead SOT-143 package.

The IC operates from supply voltages between 2.7 volts and nine volts and is claimed to be the smallest high side driver currently available. It has a typical supply current of 160 microamperes at a five volt supply voltage. In its OFF state, supply current drops to less than 1uA to prolong battery life.

The device has an internal charge pump that drives the gate output higher than the driver supply voltage and can sustain the gate voltage indefinitely. An internal zener diode provides gate-to-ground MOSFET protection and limits the gate-to-source voltage to a safe level for standard N-channel MOSFETs.

The IC is designed to switch an N-channel enhancement type MOSFET from a TTL compatible control signal in high side switch applications. It is particularly aimed at handheld and portable equipment where prolonging battery life is important.

In a low side configuration, the driver can control a MOSFET that switches any voltage up to the source-to-drain voltage rating of the MOSFET. Since the gate output voltage is higher than the typical 3.3V or 5V logic supply, the MIC5018 can fully enhance a standard MOSFET.

For further information circle 255 on the reader service coupon or contact GEC Electronics Division, 38 South Street, Rydalmere 2116; phone (02) 638 1888.

4.5ns EPROM suits 28.8K modems

Atmel Corporation recently announced it has developed and is in volume production of a family of ultra-fast non-volatile memory devices designed for Internet access and other high speed modem applications. The family encompasses 1Mb, 2Mb and 4Mb densities, in both x8 and x16 organisations.

The leading device in the family is the 45 nanosecond 1M bit AT27C010, an EPROM designed specially for 28.8Kbps, V.34 standard modems. The speed of the AT27C010 is the result of a new advanced process keyed to 0.65 micron line widths developed and installed in Atmel's Colorado Springs facility.

In 1995 Atmel will have spent some 35 to 40 percent of its revenues on construction and new production and test equipment, including about $30 million in new equipment for the Colorado Springs EPROM fabrications area. The company expects to add an additional $50 million in equipment in this area in 1996.

The EPROM is claimed to be the lowest power 45 nanosecond device currently available, making it ideal for portable as well as desktop solutions. Typical current consumption is 25mA active and less than 10 microamps standby. The IC is available in all standard 32-pin plastic packages, including PLCC, PDIP and TSOP.

For further information circle 256 on the reader service coupon or contact GEC Electronic Division, 38 South Street, Rydalmere 2116; phone (02) 638 1888. ❖

Computer Product Review:

HP's ScanJet 4c 600dpi colour scanner

Latest addition to the Hewlett-Packard range of flatbed scanners is the ScanJet 4c, which offers a basic optical resolution of 600dpi but can be interpolated and enhanced to 2400dpi. It comes complete with a dedicated SCSI adaptor and a comprehensive software package, which for IBM compatibles includes DeskScan II, Corel PhotoPaint 5, Caere OmniPage LE and Visioneer PaperPort.

by JIM ROWE

Back in the February 1993 issue, I reviewed the HP ScanJet IIp 300dpi monochrome scanner — which was one of the first of HP's 'affordable' desktop graphics scanners. Considering its very reasonable price at the time, the IIp gave most impressive results and came with a nice package of support software.

Since then, of course, scanner technology has been steadily improving. Performance has been rising while prices have been falling, partly as a result of the growth of the market for desktop publishing and computer image editing systems. And as you'd expect from a leading hi-tech firm like Hewlett-Packard, they've been playing a pioneering role in these developments.

For example nowadays HP has a very compact 'personal' monochrome desktop scanner, the ScanJet 4s, which offers much the same basic performance as the old IIp but sells for an RRP of only $731 including sales tax — complete with software. That's less than a third the price of the IIp!

However we're looking here at the ScanJet 4c, which is a foolscap/A4 colour CCD desktop scanner of conventional 'flatbed' design, rather like a slightly larger version of the IIp. Here again, though, there has been a very significant jump in terms of functionality, performance and price.

The 4c offers a basic optical resolution of 600dpi, which can be extended by software enhancement and interpolation up to an effective 2400dpi. Despite its colour capabilities, the 4c is also somewhat *faster* than earlier scanners like the IIp: for example the rated time to scan an A4 page at 300dpi is only 7.5 seconds (not including the lamp calibration time of 3.5 seconds). A preview scan takes only four seconds.

The internal resolution of the 4c is 10 bits for monochrome and 30 bits for colour, giving an improved potential brightness range of 1024 levels, or 60dB — important for capturing elusive shadow details. This high internal resolution can either be exported directly, or mapped automatically to produce the usual 8-bit greyscale or 24-bit colour scans. (A 24-bit colour scan provides a potential 16.7 million different colours, while a 30-bit scan provides a potential one billion colours!)

The 4c's maximum document size is 356 x 216mm, and it measures 585 x 368 x 105mm overall with a weight of 9.9kg. The inbuilt power supply operates from 100 - 240V AC, with a maximum power consumption of 49W. It uses a SCSI-2 interface, and the version for IBM-compatible PCs comes complete with a SCSI cable and a dedicated SCSI adaptor card. However drivers are also included to allow the scanner to be used with existing ASPI and CAM-compliant SCSI cards.

Actually if you've seen the hardware specs for the previous HP Model 3c scanner, the foregoing will probably seem rather familiar. That's because the 4c scanner itself is in fact identical with the 3c — the differences between the two are in terms of the accompanying software.

The software side

And when it comes to software, the 4c package comes with quite an impressive bundle. All of it runs under Windows 3.1 or later, and requires an ISA/EISA system with at least 4MB of RAM, 4MB of available hard disk space, a mouse, a VGA or better graphics adaptor and either a spare card slot or an existing ASPI/CAM compatible SCSI adaptor.

First of all, there's the latest version of HP's DeskScan II (V2.1), the main scanner control program. This provides all of the basic facilities to control the scanner hardware and achieve the best scanned images.

As well as providing full control of scan area, resolution, brightness, contrast and gamma law, DeskScan II now provides inbuilt sharpening. It also features automatic identification of image type (line art/greyscale/colour photo), and allows you to select any of a range of preset (but customisable) 'print path' configurations which incorporate a resolution/gamma law/sharpening combination to suit a particular output device. You can also create your own custom print path configurations.

DeskScan II also supports the TWAIN interface standard, so once it's installed you can call it directly from other image editing programs like Corel PhotoPaint or Picture Publisher.

In fact Corel PhotoPaint 5 is included in the software bundle that accompanies the ScanJet 4c, so instead of having to fire up DeskScan II to scan in an image, you can achieve the same result from inside PhotoPaint 5 — simply by clicking on 'Acquire' in the File menu.

At the end of the scan you're automatically returned to PhotoPaint, where you can save and/or further manipulate the scanned image.

The same applies if you have an editing program like Picture Publisher already installed...

(By the way instead of Corel PhotoPaint 5, the Macintosh version of the ScanJet 4c comes with Adobe PhotoShop LE.)

But that's not all, as they say in the infamous TV commercials. Along with DeskScan II and PhotoPaint 5, the ScanJet 4c software bundle also includes the Limited Edition of Caere's OmniPage OCR program, for turning scanned text into editable text files.

There's also HP's own ScanJet Copy Utility, which links the scanner directly with an HP LaserJet printer, to form a handy black and white photocopier. The Copy Utility window provides most of the facilities of a copier's control panel — letting you select the reduction/enlargement factor, copy density, number of copies and so on. Very convenient!

And to cap it all off, you also get Visioneer's PaperPort 3.0, a scanned document management/communications package designed to facilitate faxing, e-mail and word processing operations. PaperPort allows you to combine scanned pages into a multi-page document or 'stack', view them on screen, print them out, send them by fax or attach them to an e-mail message — merely by dragging them to the appropriate icon. In the same way you can have a scanned text document OCR'd and fed into your word processor, ready for editing.

You can also import and export image files, in BMP or TIFF formats. In short, PaperPort provides a very flexible and convenient way to organise and manipulate the electronic versions of your 'hard copy' information.

By the way, PaperPort communicates with the scanner via DeskScan II and the TWAIN interface. It also provides two nice little features to 'tidy up' scanned documents: the ability to 'straighten up' a page that has been scanned crookedly, and the ability to 'clean up' a page by removing the little specks that always seem to appear in scans — no matter how clean you try to keep the scanner's glass!

Trying it out

Thanks to Hewlett-Packard Australia, we were able to try out a ScanJet 4c for a couple of weeks, to try it out for ourselves. We installed it in one of the 66MHz 486DX2 machines in our office, fitted with 16MB of RAM and running Windows for Workgroups 3.11.

The installation turned out to be very easy. There was a convenient free slot to fit the dedicated SCSI controller card supplied with the scanner, and the software installed without any mishaps. The scanner itself only had to be placed on the desk and connected up to the power and the SCSI port, after disengaging the mechanical transit lock for its sensor carriage.

Getting the software and the scanner to communicate with each other was no problem, as Deskscan II comes with a 'Scanner Test' utility which can find the SCSI controller and also the scanner's address on the SCSI line. After that, we could proceed with using DeskScan II and the other software.

Frankly we were most impressed with the ScanJet 4c scanner itself, which delivers excellent quality scans in both monochrome and colour. It's also surprisingly fast in operation — much faster than the model IIp, from memory, and about twice as fast as another flatbed scanner we've been using. If we have to criticise it at all, our only gripe would be that it's a bit noisy; scanning is accompanied by fairly loud whistles and chirps, presumably from its hard-working stepper motors.

We also found the accompanying software package quite impressive. The latest version of DeskScan II provides all of the basic scanning control facilities, and is clearly designed for fast and convenient use by people who normally don't want to be bothered by the technicalities. And Corel PhotoPaint 5 is of course a very flexible and easy to use image editing program, which is no doubt familiar to many *EA* readers already.

The LE version of Caere's Omnipage package seems to provide all of the OCR performance that's likely to be needed by many people, and should be found very handy by most users. We were also quite impressed with the PaperPort program, which should save a lot of time and hassle for people who need to use their computer and scanner for faxing, turning hard copy material into electronic form and vice-versa.

Oh — and we really liked HP's little Copy Utility, which can produce surprisingly good photocopies when your system is fitted with a 600dpi LaserJet or similar. It's also very convenient to use, too.

In short, then, the HP ScanJet 4c package delivers a very high order of performance from both the scanner hardware and its accompanying software. For the quoted RRP of $2004 (including sales tax), it seems very good value for money.

There's an optional transparency adaptor available for the 4c scanner, by the way. It sells for a further $1362 including tax. A cut-sheet feeder is also available.

Further information is available from Hewlett-Packard Australia, by ringing its sales assistance number 131 347 — which is toll free from anywhere in Australia. ❖

NEW KITS FOR RECENT EA PROJECTS

FROM DICK SMITH ELECTRONICS:

ESR-Low Ohms Meter (January 1996): The DSE kit is complete with case, pre-punched and silk screened front panel, and tinted perspex filter. It includes pre-programmed micro, all specified components and test leads with clips. Cat. No. K-7404, it is priced at $59.50.

PC-Driven EGO Analyser (Jan/Feb 1996): The DSE kit is complete with case, pre-punched and silk screened front panel, all specified components, cable/connectors for the printer port cable, and software on a 3.5" disk. Cat. No. K-4214, it is priced at $49.95.

FROM JAYCAR ELECTRONICS:

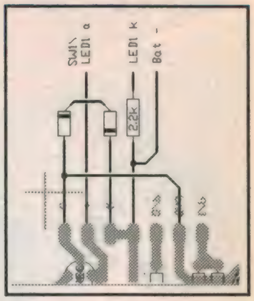
Dual 12V Battery Manager (Jan/Feb 1996): The Jaycar kit is complete with case, PCBs and all specified components. Cat. No. KA-1782, it is priced at $44.95.

ESR-Low Ohms Meter (January 1996): The Jaycar kit is complete with case, silk screened front panel, pre-programmed micro and all specified components. and test leads with clips. Cat. No. KA-1783, it is priced at $69.50.

PC-Driven EGO Analyser (Jan/Feb 1996): The Jaycar kit is complete with case, silk screened front panel, all specified components and cable/connectors for the printer port cable, but less software. Cat. No. KA-1781, it is priced at $37.95.

NOTE: This information is published in good faith, as supplied by the firms concerned and as a service to readers. Electronics Australia cannot accept responsibility for errors or omissions.

NOTES AND ERRATA



PC-driven EGO Sensor Analyser (January/February 1996): VR1 is listed incorrectly in the parts list — it should be 1k as shown in the circuit diagram, while capacitor A2 on the overlay diagram is really C6, and its positive leg should go to battery positive.

Also we have found that some TL074 ICs are not able to sink enough current to drive the opto-couplers fully. To rectify this, we have come up with a simple modification to fix this problem. Cut the track between the junction of resistors R31/R32 and pins 1 and 2 of U1, and also, replace R21 and R22 with two 1k resistors.

Remove the 'Power' LED, and install a pair of 1N4148 silicon diodes wired in series in its place, and reconnect the 'Power' LED with a 2.2k dropper resistor directly across the 'Bat+' and 'Bat-' terminals. Finally, connect the 'Sig. ground' terminal to the 'LED1 a' terminal with a short length of hookup wire. The diagram below shows the additions needed.

A number of readers have pointed out that the front cover of the January issue shows an engine running with a lambda of 1.38 and that the AFR and oxygen percentage calculations were incorrect.

The values shown were 'hard wired' on the display, as the software had not been finalised in time for the photo. Rest assured that the finished version of the software calculates these values correctly.

Computer Applications Feature:

VIRUSES & OTHER SECURITY RISKS FOR THE PC USER

With new kinds of computer virus constantly appearing to infect the world's computers, those who have committed themselves to providing virus protection software have a never-ending job. However the flood of new 'nasties' is only *one* of the challenges a firm like Australia's Cybec faces in keeping its popular 'VET' anti-virus package up to date, as the firm's founder and MD explains in this article.

by ROGER RIORDAN

Almost seven years ago, while I was lecturing at Chisholm Institute of Technology, I met my first PC virus. Today there are something like 8000 known viruses, and almost everyone has met one. So what is new? Well, as you would expect, we have been flat out trying to keep up with this flood of viruses; but far too much of our time has been devoted to overcoming problems introduced by the PC designers. For instance...

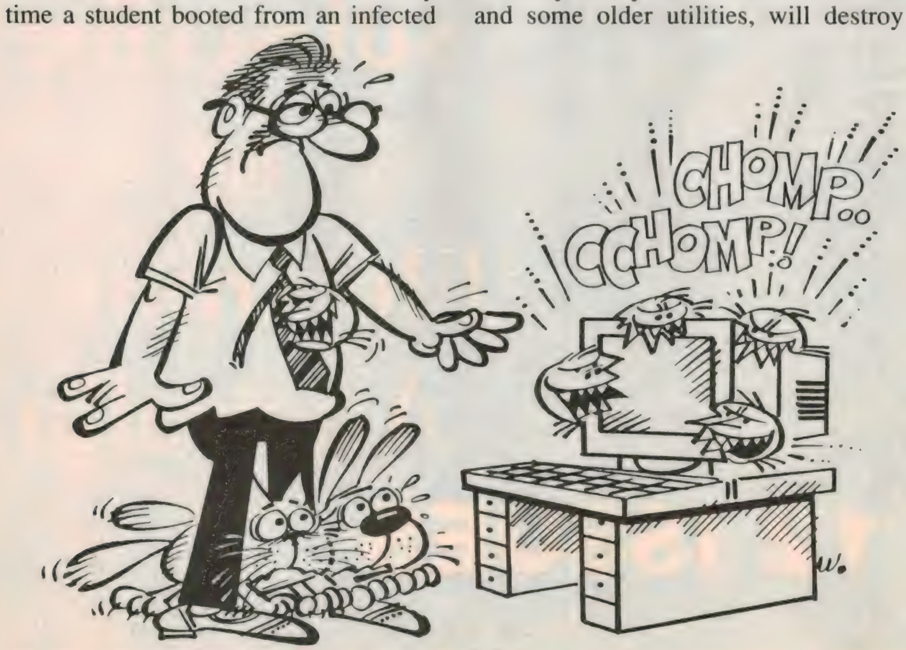
'Big' IDE drives

I only became involved with viruses because we had a lab full of Olivetti M24s. These had a non-standard hard disk layout, and when the 'Stoned' virus (which was not intended to be destructive) infected them it saved the original Master Boot Record (MBR) in the middle of the Partition Record. So every time a student booted from an infected floppy everything on the hard disk had to be re-installed.

This old incompatibility recently resurfaced again, because of a kludge to overcome an oversight in the design of the original PC AT. 20MB was a BIG hard disk then, and no-one noticed that the maximum hard disk capacity was effectively limited to 528MB. But in recent years the demand for hard disk space has risen at an astronomical rate, and about two years ago this limitation became a serious problem.

Several hard disk manufacturers had the bright idea of providing a special driver which patched the BIOS so that it could handle bigger hard disks. Unfortunately they put this driver in the now almost universally unused area following the MBR, on the first sector. So what was wrong with this?

Firstly nearly all boot sector viruses, and some older utilities, will destroy the driver and make it impossible to access the hard disk. Secondly, most anti-virus (AV) software recommends that if you think a PC has a virus you should boot from a clean floppy — but if you do so you won't be able to access the files on the hard disk at all, and, worse, the MBR and the disk configuration will both appear to have changed.



This raised considerable problems for us. There could now be three boot sectors, any or all of which could get infected by viruses under various circumstances, and three ways you could boot the PC — and we had to deal with an incredible number of permutations. Naturally we could not expect the user to understand all of this, or make meaningful choices if the program was uncertain about anything.

We think we have managed to overcome these problems, but if you have one of these drives you are living just a bit more dangerously. As always the answer is to make regular backups. Sooner or later your hard disk WILL FAIL!

Flash BIOS

In early PCs, the BIOS was contained in read-only memory (or ROM). This meant that it could not be corrupted; but it could not be updated either.

Several years ago manufacturers began using 'Flash' ROMs, which could be re-programmed in situ. This made it easy to update the BIOS to add new features, or fix bugs — but it also provided another security loophole.

So far no viruses have exploited this feature, but last year a dealer brought us a PC which played 'Happy Birthday', and then hung, on Monday 17th of November. We assumed it had a virus,

so we booted it from a clean floppy. It played the tune! We removed the hard disk. It played the tune! We took out the floppy drive as well. It *still* played the tune.

Eventually we established that the BIOS contained a trojan, set to trigger on this date. The PC had a Flash BIOS, but in this case the trojan was almost certainly introduced during manufacture, as a large number of PCs were affected round the world.

Non-standard Setup

The Junkie virus, written in Sweden, has been very prevalent recently. Although it is a multipartite virus (which infects both executable files and hard disk boot sectors) it is normally easily removed. However a number of Compaq users reported that the virus would reappear every time they ran Setup.

Eventually we established that in these PCs the Setup program is contained in a special hidden partition. In normal circumstances this is totally inaccessible, but if the user boots from a 'Setup' floppy, or hits the right key combination while booting, it will be loaded and the setup programs run.

If the MBR is infected with a multipartite virus the virus will be active in memory, and will infect the setup programs, but when the PC is re-booted they will again be inaccessible and no normal AV software will be able to disinfect them. We have written an inhouse utility to disinfect them, but have not yet released it for general use.

So far we have been talking about problems caused by shortsighted decisions made by the 'good' side. But what has the 'dark' side been up to?

Polymorphic viruses

Encrypted viruses have been around for a long time, but this just meant we had to look for the decryption procedure. However polymorphic viruses were introduced several years ago, in which every copy of the virus has a different decryption process, and this is often camouflaged with vast numbers of 'do nothing' instructions. These are a lot more bother to detect, but they are also much harder to write; so there are not too many of them, and we have been able to keep up with them as they appeared.

The latest variant is a virus called FITW. This is stealth, polymorphic and multi-partite, but the new twist is that even the boot sector has a polymorphic encryptor. Once again we have had to introduce a new procedure to detect this, but again it has only been a nuisance.

'Macro' viruses

Most application programs — word processors, spread sheets and the like — now provide complex macro facilities, and for some time there have been warnings that these pose a serious security risk. These fears were proven during the Windows 95 launch, when a widely distributed CD was found to contain a Word document infected with a brand new macro virus.

Merely reading the infected document is enough to infect Word, and all documents subsequently accessed by Word will be infected. Traditional viruses infect files with a well documented structure, become active under well defined circumstances, and are limited to a particular operating system, but macro viruses infect files with an ill-defined structure, are activated under undocumented conditions, and can operate on any platform supporting the host utility. The Word macro viruses will certainly run on both PCs and Macs, for example.

Furthermore 'classical' viruses have to be disassembled before you can study them, and require some skill to write, whereas macro viruses are self

Continued on page 120

SPOTLIGHT ON SOFTWARE

DART — Digital Audio Restoration Technology

Tracer Technologies' DART package should be of great interest to anyone involved in improving the quality of audio signals — like 'rescuing' old and noisy recordings. Reasonably low in cost, it runs under Windows 3.1 or Windows 95, on a 486 or better PC fitted with a 16-bit sound card. Yet it offers many of the filtering, smoothing and other DSP noise removal features previously only available on costly audio restoration systems.

by JIM ROWE

A couple of years ago, during a visit to the National Film and Sound Archive in Canberra, I had a demonstration of the system they were using to 'rescue' old and noisy audio recordings from Edison cylinders, early discs and film sound tracks. Based on some dedicated professional hardware plus a suite of fairly expensive software packages running on a high-end Macintosh computer, the NFSA system used digital signal processing techniques to achieve very impressive results. Background noise could be dramatically reduced, clicks and crackles removed, and frequency response peaks and dips smoothed out — so that old recordings that had sounded 'hopeless' could be restored quite remarkably.

For someone like myself with a long-time hobby interest in old recordings and films, it was particularly impressive. At the same time I couldn't help being frustrated, because similar facilities were not available at a more reasonable cost for amateurs!

Well, *now* there is. It's called DART (standing for Digital Audio Restoration Technology), and it comes from a firm in Dallastown, Pennsylvania (USA) called Tracer Technologies.

DART is a software package that runs on a standard IBM compatible PC, under either Windows 3.1 or Windows 95. This means that the PC really needs to have a 486 or better CPU, although I gather it *will* even work on a 386 machine — preferably one fitted with a co-processor.

Not surprisingly the PC also needs to be fitted with a Windows compatible 16-bit sound card, to provide the audio input and output hardware. There are no other special requirements as far as the sound card is concerned, although the overall audio performance will inevitably depend to some extent on the quality of the card's audio codec (A/D and D/A) circuitry. Serious users will no doubt want to use the best card they can, although surprisingly good results can be obtained with a standard 16-bit Sound Blaster or similar.

As the name suggests, DART's main function is to allow you to perform restoration work on any audio material which is degraded by clicks, pops, surface or ground noise and other nasties. It allows you to capture/record the original audio on hard disk as a digital WAV file, view it visually as a 'sound file' on screen, apply a variety of DSP processing functions to it, listen to the result each time and finally output it again in conventional analog form, when you've achieved the desired result. And all of these operations can be done easily, intuitively and *interactively* — thanks to DART's design and the Windows GUI (graphical user interface).

There are three main audio restoration 'tools' available in DART, described collectively as the 'Tri-Cleanse Process'. The first tool is Smoothing Factor, which uses a Kalman digital filter to smooth/reconstruct the audio signal at the beginning of the noise cancelling process. Then comes the PostFiltering Factor, an adaptive filter which removes surface noise, hiss and other relatively

constant degradation. Finally there's the Outlier Detector, which detects clicks, pops and other impulsive noise events, and automatically removes them.

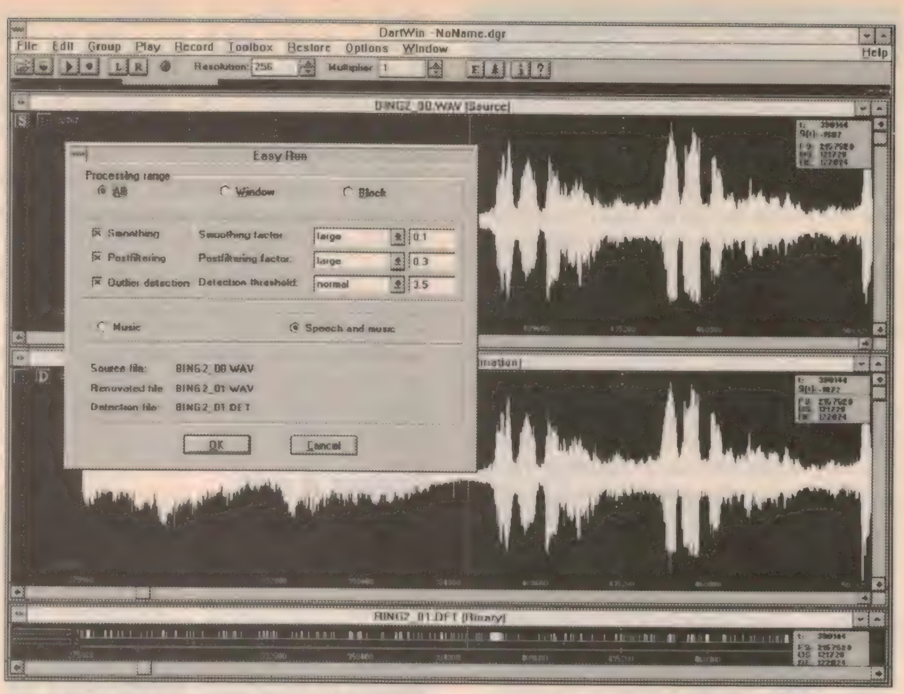
Each of these restoration tools can be independently enabled or disabled, and when enabled is adjustable in terms of degree. As a result it's easy to experiment with different combinations of the various kinds of processing, and work out the most effective combination for any particular restoration job.

All of this processing is performed by taking one WAV file, the 'source' file, passing the samples through the processing algorithms and storing the results in a second 'destination' file. Initially the source file is of course the original signal, but for later processing steps it may, if you wish, be a file created by an earlier stage. This way your initial 'before any processing' signal file always remains intact, in case you make any mistakes and need to start all over again. You can also keep intermediate files intact for reference, if you're happy with them.

As you can see, the restoration processing is not performed in real time; you can't clean up a noisy audio signal 'on the fly', as much as one might like to do so. There's a huge amount of processing involved in this kind of DSP, and doing it all in real time would probably need at least a high-end workstation. The only way it can be done on current PCs is by processing one file to produce another, and then listening to the result.

Mind you, DART's processing tools are pretty fast. On the typical 90MHz Pentium system we've been trying it out on, with 16MB of RAM, 256KB of L2 cache and a fairly fast 540MB IDE hard disk, processing typically took only 1.6 times the real-time playing time of a mono 16-bit sound file recorded at 22kHz. So you didn't need to wait long to hear the results. A stereo signal sampled at 44kHz would obviously take longer, though, while a mono signal sampled at 11kHz tends to take *less* time...

No doubt you've realised from these comments that DART allows you to record the audio signal in either mono or stereo, and with a choice of the three sampling rates mentioned. You even have a choice of 8-bit or 16-bit sampling. This sort of flexibility is important, because although a perfectionist might want to use the highest possible sampling rate and sampling resolution to achieve the best possible result, there's really no advantage in sampling an old



Visible in this screen dump is an original sound file in the top window, with a processed version beneath it and DART's binary detection file just visible in the lowest window. The dialog box shows some of the processing options.

mono recording in stereo, or sampling it at 44kHz when it contains no useful signal components above 5kHz. For such a signal you might as well sample in mono at 11kHz, because there'll be virtually no difference in the results.

In fact there's a big penalty for using too high a sampling rate, or recording unnecessarily in stereo: the resulting WAV file will take up a lot more space on your hard disk(s), and so will the files created by DART's processing. In fact the only real limitation on the audio signal material that DART can process, in terms of duration, is imposed by the free space on your hard disk(s).

Stereo sampling will produce files twice as large as mono sampling, and the higher the sampling rate, the larger those files will be. So unless you have one or more 1GB drives, realism is the order of the day...

When you're capturing/recording your original audio file, DART gives you an on-screen 'LED level meter' to make it easy to set up and monitor the signal level for optimum sampling. For mono sampling there's a single column of 10 'LEDs', with a second column added for stereo. In each case nine of the 'LEDs' are green, and calibrated at signal levels from 0dB down to -24dB, while the top 'LED' is red to indicate sampler overload.

A set of 'tape deck' buttons makes capture/recording easy, with a 'pause' button which allows you to set the correct level before you start. You even get a display showing how much free space is available on your hard disk, and the recording time this equates to for your selected sampling mode and rate.

Getting back to DART's restoration processing, as well as the ability to manipulate the three main restoration tools there's also a choice of two different processing modes, labelled 'Music' and 'Speech and Music'. These have differing processing algorithms, and the first tends to give somewhat better results with instrumental music and singing, etc., while the second can give better results with pure speech and some kinds of solo vocal material with relatively weak backing.

In addition to these important restoration tools, DART also provides a powerful set of more general DSP tools. For example there's an eight-band graphic equaliser, which can be used to smooth and extend the response of early recordings; a set of easily programmable low pass, high pass, bandpass and notch filters; a scaling tool, to make adjustments to signal level, and a 'Maximise' tool, to automatically increase the level of a file to the maximum possible while avoiding clipping; and a convenient set of WAV file editing tools to allow cutting and pasting, etc.

There's also a Reverse tool, which swings the samples of a file into reverse order — handy because with some material, the restoration tools can give

better results when they process the file 'backwards'. (After processing it can be flipped back again, of course.)

With all of these general DSP tools, and also with the three main restoration tools, you have a choice of three processing 'ranges': All, Window or Block. These respectively select for processing either the whole source file, only the section currently visible in the screen window(s), or only the material in a selected block. This gives great flexibility, as you have not only the ability to 'try out' a restoration or filtering recipe quickly on a selected part of your file, but also the option of performing additional work on a section that needs it.

By the way the Window option is itself more flexible than you might think, because the sample range visible in a file window is easy adjusted over a wide 'zoom' range.

This ability to select All, Window or Block mode also applies to DART's Play mode, which can also be set to begin playing from the current position of a marker cursor if you wish. The program also offers the ability to attach audible 'click markers' to a file, in any desired position, to define the location of a disturbance. The markers do not become a part of the file itself, and can easily be removed later.

Other nice features of DART include an elegant system of managing your sound files, using a 'SoundTree' with each original file as its root, and also the ability to perform automatic filling of marked small or medium-sized dropouts, from either preceding or following material. This can be done for gaps with a duration of up to 1500 samples.

Trying it out

DART comes on two 3.5" floppy disks, and installs very easily with its own SETUP program. The package includes an informative Technical/ User manual, and there's a special 'KickStart' section which leads you through the process of restoring a sample noisy file, to get you up and running.

After doing this I tried capturing a number of samples of known poor recordings from old discs (both commercial pressings and home-brew acetate recordings) and film sound tracks, and then spend quite a few interesting sessions with DART, using its tools to see what I could achieve.

Frankly, I'm very impressed. DART provides some powerful DSP tools for sound file restoration, and once you get the hang of what each tool is best at doing, it seems to have the ability to achieve a surprising amount of improvement.

For anyone involved in trying to rescue old sound recordings, then, it should be of great interest and potential value.

DART is priced at $695, and is available from Australian distributor Mainly Multitrack, of Unit 20, 2 Garden Boulevard, Dingley 3172; phone (03) 9558 1155, or fax (03) 9558 1514.

Incidentally Mainly Multitrack is a Australian pioneer in the digital audio area, having specialised in this technology for quite a few years. In addition to distributing DART from Tracer Technologies, they also handle high-end sound cards, MIDI interfaces, samplers and sequencing/editing and other music software from firms like Turtle Beach, Voyetra, SEK'D, IQS, Blue Ribbon and IBIS. ❖

Viruses & Other Security Risks

Continued from page 117

documenting, readily understood, and easily modified using the normal macro editor. Already a number of variants have appeared. Microsoft is about to introduce a common macro language for all their applications. This will enable macro viruses to spread from documents to spreadsheets to databases, presentations, and so on — and to any platform which will run any Microsoft application. Macro viruses will almost certainly also appear for competing products.

These viruses require a new approach, as it is not feasible to do a full search of every file on the hard disk. The two most promising lines are to test every document opened to see if it is a potential carrier, and if so to search the macro section for viruses, or to write a resident macro checker which can hop in whenever a macro is to be executed. This is the more elegant approach, but will take some time to develop, as it requires a detailed understanding of the undocumented inner working of the application...

Conclusion

At Cybec we have been fighting viruses for nearly seven years now, and for all this time the Jeremiahs have been predicting the imminent demise of our scanners in the face of the latest undetectable viruses. But we have kept up, and if you practice good housekeeping (and use a good AV program), you are still far more likely to lose data through carelessness or mechanical failure than from viruses. So make sure your backups are up to date, and kept in a safe place. Happy computing!

Roger Riordan is an acknowledged authority on computer viruses and virus protection techniques. His company produces the very popular 'VET' package, available from many software dealers. Further information is available from Cybec at PO Box 205, Hampton 3188, or phone (03) 9521 0655. ❖

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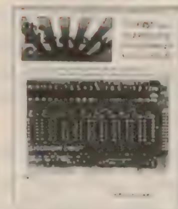

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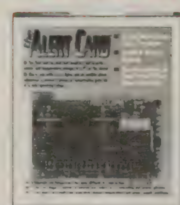

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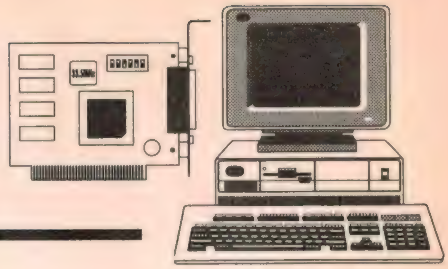


Data projection system

The BARCODATA 808 projection system features high brightness 8" electromagnetic focus CRTs with digitally controlled dynamic astigmatism. It has a light output of more than 1000 lumens at 10% peak white.

The digital dynamic astigmatism circuits provide improved spot size and shape, and the high definition F1.06 hybrid lenses with centre and edge focus adjustment further enhance the sharpness and contrast of projected images on screens up to six metres wide.

A horizontal scan frequency of 15 to 69kHz and 75MHz RGB bandwidth amplifiers make the system compatible with a wide range of PC graphic boards with resolutions up to 1190 x 900 pixels/60Hz. This makes it suited for presentation and training applications, multi-media events, trade shows and boardroom meetings.

For further information circle 162 on the reader service coupon or contact Trace Pacific, 8 Prohasky Street, Port Melbourne 3207; phone (03) 9646 5833

Modem development kit

The DB900 modem development kit is a complete test platform to demonstrate and test the MX909A, MX919A, and MX929A components. These parts include Gaussian filtered minimum shift keying (GMSK) or four level frequency shift keying modems which execute a rich set of communication protocol tasks.

Automated modem functions include: bit and frame synch; forward error correction (FEC); cyclic redundancy checking (CRC); header, intermediate, and last block Tx and Rx; data interleaving for FEC enhancement; and support for protocols such as Mobitex, TD-LAB, and ARDIS.

The kit includes a pair of complete baseband modem circuits; one pair each of the MX909A, MX919A and MX929A components; PC software; and a hardware interface to connect to the parallel port of a Microsoft Windows compatible personal computer.

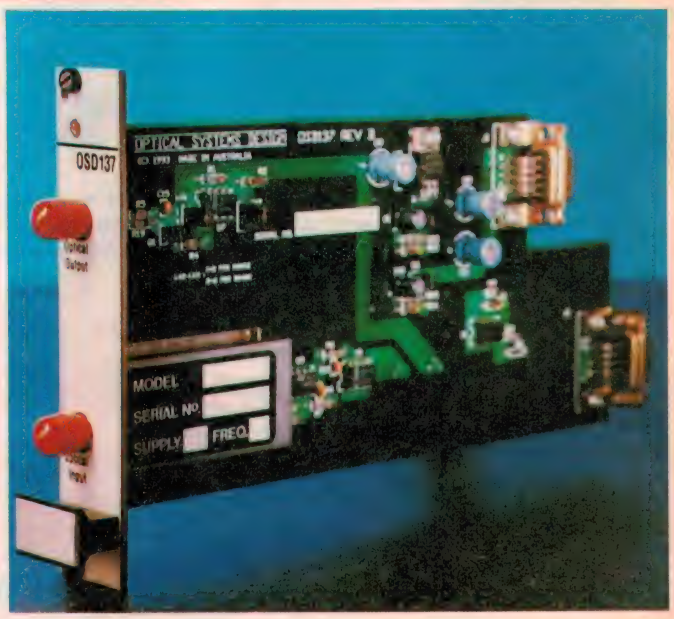
For further information circle 167 on the reader service coupon or contact

Optical modem card

Optical System Design has announced its OSD137 modem card which plugs into OSD's standard OSD370 chassis. It accepts up to fourteen OSD standard cards and one OSD911 power supply module.

The card is compatible with the OSD135 RS422 module and has unique features such as TTL, RS422 or RS232 operation. A pair of ASD137 short haul modems (or a combination of OSD135 and OSD137 modems) and a duplex optical fibre cable form a link that is a direct replacement for twisted pair extension cables. This link provides an effective way of extending cables from building to building while providing EMI/RFI protection, data security, reduced data error rate, and elimination of ground loops. The OSD137 supports full asynchronous data rates up to 1Mb/s and operates at up to 5km of standard low cost multi-mode fibre optic cable with practical link margins. The OSD137L can operate over a minimum of 10km using single mode fibre.

For further information circle 161 on the reader service coupon or contact Optical Systems Design, PO Box 891, Mona Vale 2103; phone (02) 913 8540.



Veltek Australia, 18 Harker Street, Burwood 3125; phone (03) 9808 7511.

Serial text terminal

The new Lucas Deeco family of compact UX2200 VT320 text terminals for industrial and commercial applications meet NEMA 4/12 (IP65). They are sealed in a ruggedised cast aluminium enclosure to withstand mechanical abuse typically found on the factory floor and in warehouses. With the terminal, the user can access text data or control a remote host computer by using a VT320 compatible keyboard.

The terminal uses a flat panel display to maintain a compact design measuring 81.3mm deep, 296.2mm high and 294.6mm wide. It comes with a 640 x 200 pixel electroluminescent display for indoor applications, and is also available with a sunlight readable transflective LCD display for outdoor and bright light areas such as test and inspection areas.

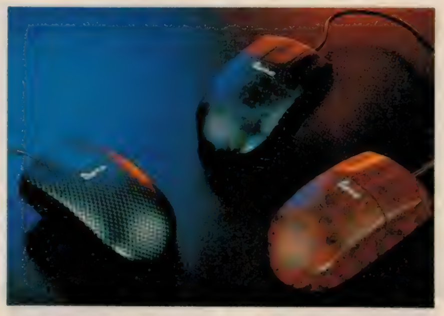
Lucas Deeco also offers a NEMA 4/12 (IP65) rated VT320 compatible keyboard for use in wet or dusty applications.

For further information circle 163 on the reader service coupon or contact Amtex Electronics, PO Box 285, Chatswood 2057; phone (02) 805 0844.

Coloured mouses

Genius has released the MyMouse range of coloured mouse devices. The MyMouse comes in three colour blends known as Leopard, Cobra and Blue Coral and is packaged with a mouse pad, advanced MouseMate driver software and Media Mate presentation software.

The MouseMate driver software allows the user to customise mouse button assignments, cursor shape and



growth as well as change the speed, acceleration and double click properties of the mouse. The MyMouse is priced at $32.

For further information circle 165 on the reader service coupon or contact Genius Australia, 4 Briar Court, Fulham Gardens 5024; phone (08) 235 2388.

Network design and configuration software

Interworld Electronics has announced LAN Designer network design software for Ethernet, FDDI and Token Ring networlds.

The software can test various physical configurations and provides component and installation cost estimates. It has been developed to expose protocol errors, issue warnings where designs cause spec violations, installation problems or outstrip site power and cooling limitations. It also provides reports for bill of materials, installation sequence, installation time estimates, tool requirements, spare parts list, site energy and HVAC requirements and software recommendations.

The software is aimed at network consultants, electrical contractors and construction personnel and network specialists. It needs MS Windows 3.0 3.1 or OS2 V2.1; 2MB of RAM; 1MB of HDD space and EGA (or better) video.

For further information circle 166 on the reader service coupon or contact Interworld Electronics and Computer Industries, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 9563 5011.

RS-485 radio leased modem interface

The ADAM-4530 is a low cost RS-232/485 converter, specifically designed to interface any bidirectional RS-485 device with a radio/leased modem. Radio/leased modems are used in data acquisition applications where the sensor data is sent to the host computer over large distances. This unit provides an interface between the radio modem and RS-485 data acquisition devices.

Most RS-485 devices have a response time that is much faster than the transmitter turn-on delays required by many radio/leased modems. In addition, radio/leased modems also require an RS-232 signal to activate the transmitter. The ADAM-4530 provides user-programmable delay times between the modem's transmitter key signal (RTS) and the transmitted data. This is done with an on-board microprocessor.

The RS-485 standard supports half duplex communication, meaning a single pair of wires is used to both transmit and receive data. Handshaking signals such as RTS (request to send) are normally used to control the direction of the data flow, but a special I/O circuit in the ADAM-4530 automatically senses the direction of the data flow and switches the transmission direction. No handshaking signals are necessary.

For further information circle 168 on the reader service coupon or contact Priority Electronics, 189 Bay Road, Sandringham 3191; phone (03) 9521 0266.

Networking for small businesses

Accton Technology has released a family of networking products aimed at smaller organisations.

"The products have been created in response to smaller organisations needing to apply the networking technology traditionally associated with larger companies," said Mr A.J. Hung, Senior Director of Accton.

"With the release of Microsoft Windows 95 and the growing use of Internet in commercial applications such as electronic mail, the necessity for small businesses to enjoy the benefits of simply installed, productivity enhancing technology have increased enormously," he said.

The adaptor cards use Microsoft's 'Plug and Play' standard and no special configuration is needed with Accton's 'Zero Step' installation, as the adaptor automatically configures itself at power on. Switched and smart hubs have a comprehensive LED display to clearly identify their operational state.

For further information circle 164 on the reader service coupon or contact Accton on (02) 858 2436.

Pentium CPU board

The SB586PV range of plug in CPU boards from Industrial Computer Source are fully featured boards designed to bring PCI bus capabilities to single board plug in ISA bus systems.

Telecommunications tester with touchscreen

The ANT-20 advanced network tester from Wandel & Goltemann is claimed to be the first telecommunications test set for installation and inservice applications to make use of a touchscreen. With its Microsoft Windows user interface, the instrument lets you point with a pencil or finger to the spot in the menu where you wish to make an entry, and the instrument responds immediately.

The user interface of the ANT-20 is oriented towards test applications rather than parameters. It handles tests on systems based on SDH and/or SONET standards as well as ATM. Selectable features include optical interfaces up to STM-16, a jitter generator and jitter meter.

For further information circle 202 on the reader service coupon or contact Wandel & Goltemann, 42 Clarendon Street, South Melbourne 3205; phone (03) 9690 6700.

These eight layer boards have a ZIF (Zero Insertion Force) CPU socket for easy upgradeability of the CPU. The board employs a fully featured, flash upgradeable AMI WINBIOS and the current Pentium 90, 100, 120 and 133 CPU chips are supported. The board will support up to 192MB, 64-bit wide DRAM main memory, as well as 256KB, 64 bit asynchronous or up to 1MB synchronous cache.

The board comes with on-board PCI bus EIDE and SCSI-2 controllers and a VGA controller which supports a resolution up to 1280 x 1024 x 256 (non-interlaced). The EIDE controller supports two fixed drives, and the SCSI controller supports a mixture of FAST and FAST/WIDE (eight or 16 bit) devices. A floppy drive controller is also included.

The board also has two high speed 16550 UART compatible serial ports and one Centronics bidirectional parallel port with EPP and EPC capabilities.

The boards have an extremely high reliability (mean time between failure rate is in excess of 90,000 hours), as well as an operating temperature range of 0 - 60°C.

For further information circle 169 on the reader service coupon or contact Interworld Electronics and Computer Industries, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 9563 5011.

PC diagnostics software

The Troubleshooter hardware diagnostics software from AllMicro is self booting and operating system independent. This package allows you to directly test your computer and isolate hardware faults. Importantly, the software will run on all Intel or Intel-compatible processors including Pentium based systems.

Troubleshooter will identify your computer's hardware without confusion caused by device drivers, network shells, drive reassignments, caching and RAM drives. It can perform a range of tests, including: motherboard (CPU, DMA controller, CMOS settings and RAM, real time clock, system timers, interrupt controller, co-processor); memory; hard and floppy drives; serial port; parallel port; video card; multimedia (CD-ROM, PC speaker, FM synthesiser and PCM sample test); keyboard; and mouse.

For further information circle 205 on the reader service coupon or contact Interworld Electronics & Computer Industries, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 9563 5011.

Digital camera for PCs

Connectix QuickCam for Windows, and Windows 95, is claimed to be the first digital video camera that plugs directly into a Windows based computer. It allows home and business users to make instant snapshots and videos with a computer.

Available for an Australian RRP of $299 (including tax), the QuickCam plugs into a standard parallel port of virtually any PC. It is powered by a pass through connector from the keyboard port.

QuickCam includes all the necessary software to let users begin taking pictures and making movies immediately. QuickPict captures still photos in formats that can be used with virtually any Windows application that supports BMP

or TIFF formats. QuickMovie provides basic video recording and playback features. Being digital, the output from QuickCam's CCD imaging chip does not need to be converted to an analog video signal, so there's no need to install a digitiser board.

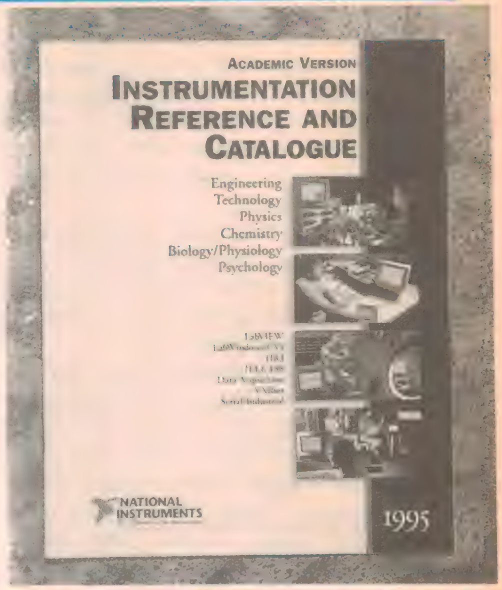
Picture quality is therefore not affected by image interpolation, analog compression, analog conversion or other processes. The brightness and contrast settings are automatic. The camera gives still and video images at up to 320 x 240 pixels in size with 64 shades of grey. Video images are typically captured at 15 frames per second or more.

Weighing about 110 grams, the QuickCam package includes a black and white digital camera, QuickMovie and QuickPict software and Microsoft Video for Windows runtime software. It will be available through most computer resellers Australia wide.

For further information circle 207 on the reader service coupon or contact Firmware Design, 28 Coombes Drive, Penrith 2750; phone (047) 21 7211; http://www.firmware.com.au.

Academic catalog of virtual instruments

National Instruments has announced a 16 page, academic version of the company's 1995 *Instrumentation Reference and Catalog* (Part No. 350233A-01). Instructors can use it to learn how to equip teaching laboratories with industry grade instrumentation application software products, such as LabVIEW



Computer based OTDRs

The compact Wandel & Goltemann OTDRs in the DominoFIBER series (OFT-30/OFT-50) are claimed to have the features of fully equipped optical time domain reflectometers. Combined with a notebook computer, the new devices are designed for installing, maintaining and troubleshooting fibre optical communications systems.

They come in single laser and dual laser versions for multimode applications at 850nm and 1300nm (OFT-30), and single mode applications at 1310 and 1550nm (OFT-50). Features include a wide dynamic range with high resolution, so you can distinguish between closely spaced events at the end of a long fibre link.

From one to eight test boxes (Dominos) are connected to a notebook PC. Date selection and entry, the menus, key combinations and file/print system conform to the Windows standard. Also useful is the auto mode. When you start Domino FIBER-OTDR, the device will automatically make the best settings and perform the measurement. Press a key and it evaluates the measured backscatter curve and displays an even table with distance indications. In Expert mode, advanced users can make manual parameter settings for sophisticated fibre analysis.

For further information circle 201 on the reader service coupon or contact Wandel & Goltemann, 42 Clarendon Street, South Melbourne 3205; (03) 9690 6700.

and LabWindows/CVI;HiQ numerical analysis and data visualisation software; and hardware for data acquisition and instrument control exercises.

The catalog includes information on low cost editions of LabVIEW and HiQ software that students can purchase for home use, and class packs and starter kits that give instructors the convenience of ordering a set of hardware and software products for laboratory use.

For further information circle 206 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 9422.

Transient capture card

The new Microlink 580 transient capture card from Biodata comes with Wavedisk ready to run software and provides a PC with 16 analog inputs. It samples signals up to 250,000 times a second and stores up to four million samples in memory. The software makes the card appear as a new disk drive within DOS. This means it suits networks, as the 580 can be made available as a network server drive.

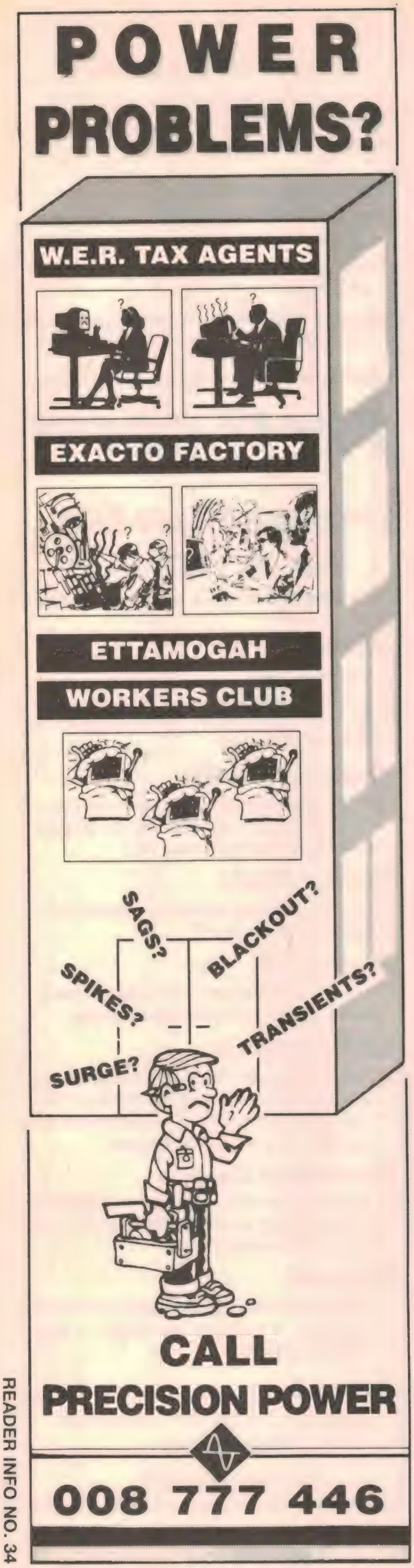
Flexible sampling is very important in transient capture. With the 580 and Wavedisk you can collect pre and post-trigger data, enable and disable channels, choose how often the channels are sampled and the time between sampling each channel.

You can start sampling from Wavedisk, or from an external trigger, synchronising data capture with external events. A trigger output lets you automatically start other equipment. You can set each channel's range separately, from a choice of 20 options. Wavedisk supports several file formats so the data can be read straight into analysis software. There is no programming required.

For further information circle 209 on the reader service coupon or contact M.B. & K.J. Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277.

Multi-screen video wall controller

Compuvision has announced the release of a PC based multi-screened video wall controller capable of displaying large screen images from any PAL/NTSC video source across multiple monitor displays.



COMPUTER NEWS AND NEW PRODUCTS

The design comprises a main controller board (a full size PC bus card) that interfaces to any 16 bit ISA compatible PC motherboard. This board hosts a proprietary high speed video data bus which allows up to nine frame store modules to be installed.

Each framestore module can be configured as either two independent framestore channels with simple overlay control or as one framestore channel with advanced overlay control. A basic unit, fully populated, supports up to 18 independent monitor displays with one full framestore per monitor.

Various size monitor arrays from 2x2 up to 4x4 can be supported with the one controller. However, multiple wall controllers can be used in a building block arrangement to form any size wall with a square or rectangular monitor array and with any aspect ratio. It can generate all of the traditional video wall effects seen on most video walls plus a wide variety of advanced video effects not available on standard wall controllers.

The controller can accept either PAL or NTSC input standards which are compatible with either composite or S-Video signals.

The complete system is available as a unit encased in an industry standard 19" 5U rack mounting case. The controller board and framestore modules are available to OEMs.

For further information circle 210 on the reader service coupon or contact Compuvision, 193 Tucker Road, Bentleigh; phone (03) 9557 6123.

PCI GPIB board for Windows 95/PCI PCs

National Instruments has announced a high performance, low cost plug-in GPIB instrument control board for Windows 95 PCs with PCI bus. The PCI-GPIB performs talker, listener, and controller functions, including those required by IEEE-488.2.

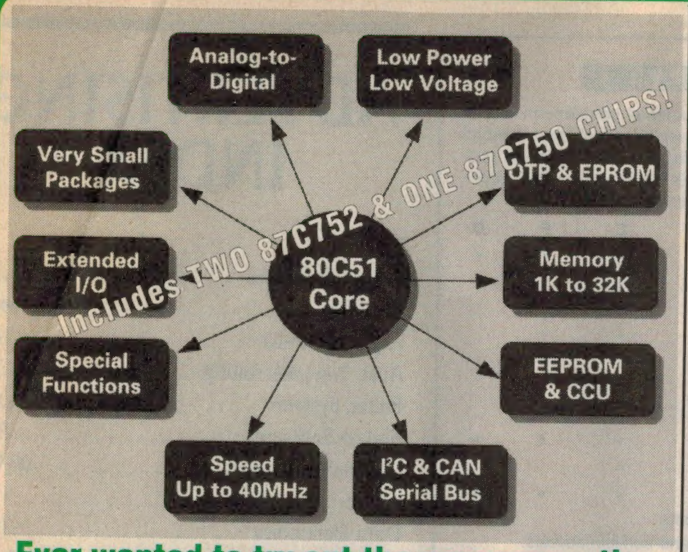
It can sustain data transfer rates up to 1.5MB/s using the IEEE 488.1 three wire handshake and implements the patented, high speed GPIB protocol (HS488) for programmed I/O data transfers of at least 3.7MB/s.

It includes Ni-488.2/M software for Windows 95, which has been revised as a 32-bit kernel-level driver, and will be compatible with the native Windows 95 versions of LabVIEW and LabWindows/CVL. A Windows 95 PC equipped with the PCI-GPIB can monitor, control and communicate with thousands of GPIB based engineering or scientific instruments and graphics equipment.

National Instruments Web page contains information on the company's Windows 95 application and driver software and hardware that will take advantage of Windows 95. Users can reach the site at http://www.natinst.com/win95.htm.

For further information circle 203 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 9422. ❖

FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...



Ever wanted to try out the new generation of microcontrollers?

Well here's the low cost way to do it with the DS-750 Development Kit from Philips for only $159.90!!

It has the following features:

- **Emulates 87C750 Microcontrollers in Real-Time**
- **Programmable Clock up to 40MHz**
- **Built-in Programmer for 87C750/l/2**
- **High-speed Hardware Simulator**
- **Source-Level Debugger for C, PLM and Assembler**
- **24-pin DIP Emulation Header**
- **Serially linked to IBM PC at 115 KBaud**

The Ceibo DS-750 supports 87C750 Philips microcontrollers at any frequency allowed by the devices. It is serially linked to a PC/XT/AT or compatible systems and can emulate the microcontrollers using either the built-in clock oscillator or any other clock source connected to the microcontroller.

The clock oscillator generates 40MHz, 20MHz, 16MHz, IOMHz and 5MHz. Emulation is carried out by programming an 87C752 microcontroller with the user software and an embedded monitor program. The DS-750 provides the on-board programming capabilities and locates the monitor in the upper 1K that is not available for the 87C750.

Three working modes are available: real-time, simulator and simulator plus. In the real-time mode the user software is executed transparently and without interfering with the microcontroller speed. Breakpoints can be added to stop program execution at a specific address. In the simulator modes, an additional microprocessor is used to take control of the 87C750 lines and to simulate its operation but not in real-time.

This operating mode allows access to all the microcontroller functions (I/O, timers, etc.) and interacts with the hardware according to the user software execution or directly by means of emulator commands sent from the host computer. The combination of the two available working modes allows an easy way to debug hardware and software functions. The software includes C, PLM and Assembler Source Level Debugger, On-line Assembler and Disassembler, Software Trace, Conditional Breakpoints and many other features.

APPLICATIONS

The main applications of the DS-750 Kit are: -

- Evaluation of Philips microcontrollers
- Demonstration of microcontroller capabilities
- Development of microprocessor based systems
- Hardware and software debugging purposes
- Training in the field of microprocessors
- Programming of Philips microcontrollers

EXPERIMENTS

Five experiments demonstrate the capabilities and advantages of the 80C51 device and its derivatives. Completing each of the experiments will provide the user with more knowledge and experience.

1: Getting to know the DS-750

This experiment carries out several exercises to describe the functions of DS-750.

2: Data Transfer Instructions

This experiment helps you to understand the different addressing modes of the devices, writing programs that use the data transfer instructions, and transfer data and code to and from different memory types.

3: Input/Output Ports

This experiment shows how to manipulate Boolean variables, use the input/output capabilities of the microcontrollers, and how to assemble programs that use the ports of a microcontroller.

4: Arithmetic& Logic Functions

This experiment will help to make calculations with the microcontroller, replace logic circuits by microcontroller functions, and to write programs that use arithmetic and logic instructions.

5: Control Transfer Operations

After completing this experiment the user should be able to understand the stack operations, write programs that use the control transfer instructions and pass control to subroutines.

The DS-750 system is supplied with a User's Manual, debugger and application software (including Cross Assembler), microcontroller documentation (huge databooks!), two samples of the 87C752 and one of the 87C750 (all windowed EPROM microcontrollers), RS-232 and interfacing cables and a power supply.

All you need to get up and running for just **$159.90**

Special Shhhh!

DIC SC-7000 DeSolder Tool

- 100W ceramic heater
- Sensor feedback digital temperature control
- Special antistatic housing and zero crossover switching to protect sensitive components
- Suction/Hot air blow switch – suck for desoldering, blow for SMD removal
- Work on up to 12 layer boards

DON'T PAY $630 – THIS MONTH ONLY

$542.90 inc tax

Call for tax-free pricing

Solder 0.7, 0.91 and 1.25 mm 250g **$7.95**, 500g **$15.95**

30W Iron 240Vac, Nichrome element, Fast Metal clad tip, 330°C. Bargain at **$18.95**

High Quality Silicone Test Leads And Accessories

Sick of those stiff plastic test leads that come with most multimeters? You know the ones that kink and produce pungent smoke when you touch them with your hot soldering iron. Well here's the answer – HCK Silicone Rubber Leads. You wouldn't believe that a 1000V/16A cable could be so flexible and they're soldering iron proof to 300°C. Check our range –

SILIVOLT Reinforced Insulated Silicone Cable		
HCK-7606-1/M	.75mm Silivolt per m	$6.55
HCK-7606-2/M	.75mm Silivolt per m	$6.55
2mm SILIVOLT 60V DC Leads (fig 1.)		
HCK-9265-1-110	2mm Blk 1.0 m Lead	$8.15
HCK-9265-2-110	2mm Red 1.0 m Lead	$8.15
2mm Attachments		
HCK-8234-1-000	2mm Blk Hook Grip	$10.85
HCK-8234-2-000	2mm Red Hook Grip	$10.85
HCK-9217-1-100	2mm Blk Stackable Plg	$1.95
HCK-9217-2-100	2mm Red Stackable Plg	$1.95
HCK-9225-1-100	2mm Blk Test Prod	$6.05
HCK-9225-2-100	2mm Red Test Prod	$6.05
HCK-9229-1-100	2mm Blk Test Tweezers	$23.25
HCK-9229-2-100	2mm Red Test Tweezers	$23.25
4mm SILIVOLT 60V Leads (fig 1)		
HCK-7288-1-105	4mm Blk 16A 0.5 m Lead	$9.70
HCK-7288-2-105	4mm Red 16A 0.5 m Lead	$9.70
HCK-7288-3-105	4mm Blu 16A 0.5 m Lead	$9.70
HCK-7288-4-105	4mm Yel 16A 0.5 m Lead	$9.70
HCK-7288-5-105	4mm Grn 16A 0.5 m Lead	$9.70
HCK-7288-6-105	4mm Vio 16A 0.5 m Lead	$9.70
HCK-7288-1-110	4mm Blk 16A 1.0 m Lead	$10.85
HCK-7288-2-110	4mm Red 16A 1.0 m Lead	$10.85
HCK-7288-3-110	4mm Blu 16A 1.0 m Lead	$10.85
HCK-7288-4-110	4mm Yel 16A 1.0 m Lead	$10.85
HCK-7288-5-110	4mm Grn 16A 1.0 m Lead	$10.85
HCK-7288-6-110	4mm Vio 16A 1.0 m Lead	$10.85
HCK-7288-1-120	4mm Blk 16A 2.0 m Lead	$13.30
HCK-7288-2-120	4mm Red 16A 2.0 m Lead	$13.30
HCK-7288-3-120	4mm Blu 16A 2.0 m Lead	$13.30
HCK-7288-4-120	4mm Yel 16A 2.0 m Lead	$12.10
HCK-7288-5-120	4mm Grn 16A 2.0 m Lead	$13.30
HCK-7288-6-120	4mm Vio 16A 2.0 m Lead	$13.60
HCK-7288-1-115	4mm Blk 16A 1.5 m Lead	$12.10
HCK-7288-2-115	4mm Red 16A 1.5 m Lead	$12.10
HCK-7288-3-115	4mm Blu 16A 1.5 m Lead	$12.10
HCK-7288-4-115	4mm Yel 16A 1.5 m Lead	$12.10
HCK-7288-5-115	4mm Grn 16A 1.5 m Lead	$12.10
HCK-7288-6-115	4mm Vio 16A 1.5 m Lead	$12.10
4mm SILIVOLT 1000V Leads		
HCK-9617-1-110	4mm Blk Stght 1.0 m Lead (fig 2)	$14.10
HCK-9617-2-110	4mm Red Stght 1.0 m Lead (fig 2)	$14.10
HCK-9617-3-110	4mm Blu Stght 1.0 m Lead (fig 2)	$14.10
HCK-9617-4-110	4mm Yel Stght 1.0 m Lead (fig 2)	$14.10
HCK-9635-1-110	4mm Blk Stght 1.0 m Lead (fig 3)	$11.65
HCK-9635-2-110	4mm Red Stght 1.0 m Lead (fig 3)	$11.65
HCK-9628-1-110	4mm Blk R/A 1.0 m Lead (fig 4)	$15.00
HCK-9628-2-110	4mm Red R/A 1.0 m Lead (fig 4)	$15.00
2mm Socket to 4mm Plug		
HCK-9227-1-100	4mm/2mm Blk Adaptor	$4.05
HCK-9227-2-100	4mm/2mm Red Adaptor	$4.05
4mm Attachments		
HCK-9120-1-100	4mm Blk Clamp Grip 50mm	$15.70
HCK-9120-2-100	4mm Red Clamp Grip 50mm	$15.70
HCK-9123-1-100	4mm Blk Coupling XHK	$3.75
HCK-9123-2-100	4mm Red Coupling XHK	$3.75
HCK-9755-1-100	4mm Blk Crocodile 34A	$7.60
HCK-9755-2-100	4mm Red Crocodile 34A	$7.60
HCK-9209-1-100	4mm Blk Crocodile 2A	$4.05
HCK-9209-2-100	4mm Red Crocodile 2A	$4.05
HCK-9206-1-100	4mm Blk Hexagonal Probe	$5.85
HCK-9206-2-100	4mm Red Hexagonal Probe	$5.85
HCK-9112-1-100	4mm High Voltage Prod	$7.05
HCK-9112-2-100	4mm Red High Volt Prod	$7.05
HCK-9113-1-100	4mm Blk High Volt Prod	$6.65
HCK-9113-2-100	4mm Red High Volt Prod	$6.65
HCK-9116-1-100	4mm Blk Hook Grip	$11.95
HCK-9116-2-100	4mm Red Hook Grip	$11.95
HCK-9119-1-100	4mm Blk Jaw Grip	$17.95
HCK-9119-2-100	4mm Red Jaw Grip	$17.95
HCK-9214-1-100	4mm Blk Panel Mount Skt	$8.35
HCK-9214-2-100	4mm Red Panel Mount Skt	$8.35
HCK-9205-1-100	4mm Blk Square Probe	$5.85
HCK-9205-2-100	4mm Red Square Probe	$5.85
HCK-9203-1-100	4mm Blk Stackable Plg	$4.35
HCK-9203-2-100	4mm Red Stackable Plg	$4.35
HCK-9230-1-000	4mm Blk Test Tweezers	$20.75
HCK-9230-2-000	4mm Red Test Tweezers	$20.75

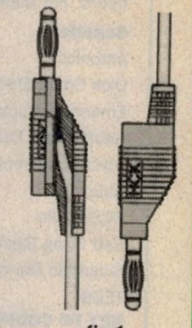
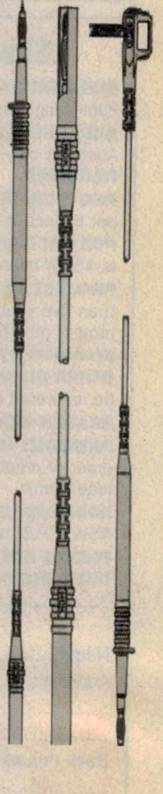


fig 1

fig 2 fig 3 fig 4



Alligator & IC Clips

TLK-JK5	5x560mm w/Alligator Clip	$6.65	IC-TEST-CLIP-48	48 Pin IC Test Clip	$34.90
TLK-JK10	10x450mm w/Alligator Clip	$10.10	IC-TEST-CLIP-64	64 PIN IC Test Clip	$42.95
IC-TEST-CLIP-08	8 Pin IC Test Clip	$7.50	MJ001.B	57mm Black IC Clip	$1.10
IC-TEST-CLIP-14	14 Pin IC Test Clip	$10.50	MJ001.R	57mm Red IC Clip	$1.10
IC-TEST-CLIP-16	16 Pin IC Test Clip	$11.85	MJ002.B	40mm Mini IC Clip	$1.00
IC-TEST-CLIP-20	20 Pin IC Test Clip	$14.75	MJ002.R	40mm Mini IC Clip	$1.00
IC-TEST-CLIP-24	24 Pin IC Test Clip	$17.45	MJ003.B	90mm Mini IC Clip	$1.55
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EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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KEY TO CODING

A	Kits and modules	D	Components
B	Tools	E	IC chips and semiconductors
C	PC boards and supplies	F	Test and measuring instruments
		G	Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Company, P.O. Box 199, Alexandria 2015; phone (02) 353 9992.

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OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

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ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria NSW 2015; phone (02) 353 0620.

PLEASE NOTE THAT WE ARE UNABLE TO SUPPLY BACK ISSUES, PHOTOCOPIES OR PCB ARTWORK OVER THE COUNTER.

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ADVERTISING INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

STOP THAT DOG BARK

NEW

Troubles with barking dogs? Muffle the mongrel and restore your sanity with the WOOFER STOPPER MK2, as published in SC Feb '96. A high power ultrasonic sweep generator which can be triggered by a barking dog. Kit includes PCB and all on-board components, plus transformer and an electret microphone. Kit is supplied with a solder-masked silk-screened PCB, and a pre-wound transformer! **$39** Single Motorola piezo horn speakers to suit (one is good, but up to four can be used): **$14.** approved I2V DC-IA plugpack to suit: **$14**

UHF REMOTE CONTROL FOR WOOFER STOPPER

Operate your Woofer Stopper remotely from anywhere in your house, even your bedside. Lets you remotely trigger your Woofer Stopper at any time. Nothing beats a randomly timed "human touch". We supply one single channel UHF transmitter, one UHF receiver and instructions: **$28**
Based on the single channel transmitter and a slightly modified version of the 2 channel receiver, as published in Silicon Chip Feb. 96. Note that this article features 3 low cost remote controls: one 2-ch UHF with central locking. 1-2 ch UHF, and an 8-ch IR remote.

FREE CATALOG

Ask us to send you a copy of our FREE catalog with your next order. Unbelievable items and kits with illustrations and ordering information. And don't forget our website at: http://www.hk.super.net/~diykit

PLASMA EFFECTS SPECIAL

Ref: EA Jan '94. This kit produces a fascinating colourful changing high voltage discharge in a standard domestic light bulb, or light up any old fluorescent tube or any gas filled bulb. Fascinating! The EHT circuit is powered from a 12V to 15V supply and draws a low 0.7A. Output is about 10kV AC peak. PCB: 130 x 32mm. PCB and all on-board components (flyback transformer included), and instructions: **$28** (cat K16) Hint: connect the AC output to one of the pins of a non-functional but gassed laser tube, amazing results! The special? We supply a non-functional laser tube for an additional **$5**, but only when purchased with the plasma kit. Total price: **$33**

MORE ITEMS & KITS

Poll our **(02) 579 3955** fax number to find out how to get our item and kit lists. MANY MANY MORE ITEMS AND KITS THAN THOSE LISTED HERE! *Ask for these lists to be sent with your next order.*

MASTHEAD AMPLIFIER

High performance low-noise masthead amplifier covers VHF-FM-UHF and is based on a MAR-6 IC. Includes two PCBs, all on-board components. For a limited time we will include a suitable plugpack to power the amplifier from mains for a total price of: **$25**

CYCLE-VEHICLE COMPUTER

9-function computer with speed, average speed, maximum speed, distance, odometer, timer, scan, freeze frame memory, and a clock. Microprocessor circuitry can be adapted to work with almost any wheel diameter. **$32** (cat G16)

AUTOMATIC LASER LIGHT SHOW

NEW

To be published in SC April or May '96. This excellent kit includes three German made DC motors with feedback windings, a PCB and all on-board components kit for an Automatic Laser Light Show driver. Mirrors included. The display changes every 5-60 seconds, and the time is manually adjustable. For each new display there are 8 different speeds for each of the 3 motors; one motor can be reversed, and one can be stopped. There are countless possible interesting displays which vary from single to multiple flowers, colapsing circles, rotating single and multiple elipses, stars, etc. etc. Requires 12V DC/300mA: **$90.** Suitable plugpack: **$14**

HE-NE LASER LIGHT SHOW

More than 10-20 times brighter than the 5mW-670nm kits! Based on He-Ne 633nm red laser heads removed from equipment that is less than 5 years old. Ideal for light shows. Output power between 2.5-7.5mW. Heads grouped according to output power range and you "get what you pay for." Head dimensions: 380mm long, 45mm dia, weight 0.6kg. A special high voltage supply is needed, and with each tube we include our 12V Universal Laser power supply kit MkIV (new transformers don't fail). Warning: involves high voltage operation at a very dangerous energy level: **$80-$140** for a 2-6mW tube and 12V inverter kit.
The AUTOMATIC LASER LIGHT SHOW can be purchased for an additional reduced price of $70 when bought in conjunction with this kit: A fantastic addition to any Disco!! This combination needs a 12V 2A DC supply such as a 12V gel battery or car battery. For 240V operation, our Wang computer power supply (cat number POI) is ideal. SPECIAL PRICE when purchased with matching laser head/inverter kit is an additional **$10.**

ARGON LASER LIGHT SHOW

To be published in SC April or May '96. Used Argon-Ion heads with 30-100mW output in the blue - green spectrum. Head only supplied. Needs 3V/15A AC (for filament) and approx 100V/10A DC for the inbuilt driver circuitry. We provide a circuit for a suitable power supply. Dimensions: 35x16x16cm, weight 5.0kg. 1 year guarantee on head. Argon heads only: **$300-$500** All heads have heaps of life left as they were used at a very low current! Needs a 1kW transformer, available elsewhere for about $180.
The AUTOMATIC LASER LIGHT SHOW included for an additional reduced price of $60 when bought with this kit: Fantastic for any Disco-club!

VISIBLE LASER DIODE KIT

5mW 660nm visible laser diode and collimating lens, with housing and APC driver kit EA 9/94 SPECIAL **$40** Suitable case and battery holder (as in EA 11/95): **$5**

VISIBLE LASER DIODE MODULE

Industrial quality 5mW/670nm laser diode modules. Overall dimensions: 12mm dia x 43mm long. Have APC driver built in and need about 50mA from a 3-6V supply. Includes housing, driver circuit and collimation lens assembled in a small module. Divergence angle less than 1 milliradian, spot size typically 20mm diameter at 30m **$65** (cat L10)

INTENSIFIED NIGHT VIEWER

Parts to make a 3-stage first generation night scope that gives good vision in starlight! Includes a 3-stage fibre optically-coupled image intensifier tube, EHT power supply kit which operates from 6 to 12V, and sufficient plastics to make a monocular 'scope. 25mm version **$270.** (cat N04), 40mm version **$300** (cat N05) Also available, a quality Peak brand I0x 'plalupe' as an eyepiece **$18.** See SC Sept '94.

MINI HIGH VOLTAGE POWER SUPPLY

NEW

Miniature potted EHT power supply (17x27x56mm) originally designed to power small He-Ne laser tubes. Produces a potent I0mm spark when powered from 8-12V/500mA DC source. Great for experiments, small portable Jacobs Ladder display, cattle prods etc. *Use on humans is dangerous and illegal: a unit built for this is an offensive weapon.* Inverter only: **$25**

12V-2.5W SOLAR PANEL

US amorphous glass solar panels only need terminating and weather proofing. Includes clips and backing glass. Very easy to complete. Size: 305x228mm, Voc 18-20V, Isc 250mA. SPECIAL **$20 ea, 4 for $60.**

Efficient switching regulator kit also available: suits 12-24V batteries, 0.1-16A panels, **$27.** Also available, simple, efficient shunt regulator kit **$5**

12V 4.4A PELTIER DEVICES

Solid state, can be used to make a thermoelectric cooler - heater. Basic info included. **$25** Two thermal cut-out switches and a 12V DC fan to suit **$10**

MINI CAR FOR CHILDREN

Battery powered car supplied with a 6V 8Ah battery and a suitable charger. Has headlights and direction lights, and is coloured red. Overall size is 1010 x 620 x 412mm (large!) Our introductory price is limited to orders placed between Feb-April. Introductory quantity is LIMITED at a SPECIAL PRICE of **$350.** Suitable speed control kit an extra **$10.**

400x128 LCD MODULE

New Hitachi LM215 400 X 128 dot matrix LCDs in an attractive housing. Driver ICs fitted but needs external controller. Effective display size 65 x 235mm. **$25 ea. or 3 for $60**

PASSIVE TUBE - SUPPLY SPECIAL

Russian passive tube plus supply combination at an unbelievable SPECIAL REDUCED PRICE: **$70** for the pair! Ring or fax for more information.

CCD CAMERA - TIME LAPSE VCR RECORDING SYSTEM

Ready made PIR detector module and learning remote control combination can trigger any domestic IR remote controlled VCR to *RECORD* human activity within a 6m range with an 180º view. Starts VCR recording at first movement and ceases recording a few minutes after the last movement has stopped. Just like commercial CCD-video recording systems costing $1000's!! No connection needed to your existing VCR. IR detector module, control kit, IR learning remote control and instructions **$90** or **$65** when purchased with our CCD camera. Previous CCD camera purchasers can claim reduced price with proof of purchase.

TINY PCB CCD CAMERA with auto iris lens, 0.1lux 320k pixels, IR responsive, has 6 IR LEDs on PCB, almost matchbox size! **SPECIAL:** This month we will include a free VHF modulator kit with every camera: Lets you use any standard TV on a VHF channel: **$180**

IR ILLUMINATOR Has 42 high-output 880nm IR LEDs (30mW @ 100mA ea). Operates from 10-15V DC, current adj range 5-600mA. Suits our CCD camera: **$40**

VHF MODULATOR for CH7-11, to connect CCD camera to a TV set. Operates TV if modulator within 50cm of the antenna. No wires! **$12** FREE with CCD camera!

REMOTE VOLUME CONTROL

SPECIAL

New high quality motor driven potentiometer, like those used in commercial stereo sound systems. Has a clutch, so can be manually adjusted. Standard 1/4" shaft, stereo (dual 20k pots) with 5V, 20mA motor. SPECIAL, reduced from $15 to **$12**
A UHF remote control kit for this unit is now available. Controller can also be used to drive electromechanical devices via relays. Kit includes commercial 2-ch UHF Tx, Rx module, PCB motor-driven pot *or* relays, PCB, all on-board components, knob, box **$60** for volume control **$55** for relay kit. Plugpack to suit **$12** See EA Dec '95/Jan '96

OATLEY ELECTRONICS

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